

Creativity Under Pressure in Digital Innovation: The Case of Norwegian Game Development Start-ups

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Abstract

In today's hypercompetitive market, companies are forced to be creative and innovate in order to survive. Digital technology has brought new possibilities for organisations as well as enabled thousands of start-ups to enter the marketplace. However, the constant flood of start-ups leads to intense competition increasing pressure on the companies to innovate. Developing novel ideas and bringing them to fruition is often a chaotic process influenced by pressure and uncertainty. The concept of creativity in information systems (IS) development and digital innovation has been under-researched with a too-narrow focus. We need to further our understanding of creative processes in IS and digital innovation, addressing the role of digital technology and human actors and their interdependence during this process in high-pressure environments. This thesis aims to extend research on digital innovation and creativity and the interaction between human actors and digital technology during this process in a high-pressure environment. A case study of game development start-up companies in the Norwegian video game industry was conducted to gain empirical insight into the work situation of a high-pressure environment with creative and technologically savvy developers. Grounded in the literature on digital innovation and creativity and guided by affordance theory, I analyse the findings using the 5 A's of creativity framework to address the need for a holistic socio-technical perspective of the digital innovation process and the interdependence of the different components influencing the creative process. In doing so, I have developed a theoretical process model, and I present propositions to guide practitioners in their creative endeavours. This contributes to research on digital innovation and creativity by addressing the need for theories explaining the role of digital technology and human actors and their interdependence during development in organisational contexts and high-pressure environments.

'Pressure makes diamonds.' – George S. Patton, Jr.

1. Introduction

Innovation within and across organisations is influenced by the spread of digital technology capable of processing, storing, and communicating different types of information. Such development trends are fuelled by the unification of previously distinct products through digital technology (Yoffie, 1996, Tilson et al., 2010). New possibilities also emerge through market disruption and digital innovation (Yoffie, 1996), that is, ‘A product, process, or business model that is perceived as new, requires some significant changes on the part of adopters, and is embodied in or enabled by IT’ (Fichman et al., 2014, p. 330). Digital technology has brought new possibilities for organisations as well as enabled thousands of start-ups to enter the marketplace. Start-ups are new and small businesses designed to create new products and services under conditions of extreme uncertainty and are accompanied by high innovation-driven growth (Ries, 2011). The constant flood of start-ups leads to intense competition. For every wildly successful start-up, thousands fail and disappear (Szmigiera, 2019). As much as 90% of start-ups are estimated to fail (Krommenhoek, 2018). This hypercompetitive market, where competitive advantages are short-lived, forces companies to be creative and innovate in order to survive. It is no longer a question of *if* companies should innovate, but *how* they should innovate (Figuroa and Conceição, 2000, Iden et al., 2013). Innovation depends on the ingenuity and creativity of employees and management, but developing novel ideas and bringing them to fruition is often a chaotic process influenced by pressure and uncertainty (Müller and Ulrich, 2013). Müller and Ulrich (2013) define creativity as the creation of novel ideas by individuals or groups, whereas innovation is the adaptation and commercialisation of these ideas in an organisational context. Hence, these two concepts have different meanings yet are intertwined and need to be considered in correlation.

For more than 20 years, it has been said that the subject of creativity is a neglected area in the literature of the information systems field (Couger et al., 1993, Seidel et al., 2010, Müller and Ulrich, 2013). According to a literature study by Seidel et al. (2010), the focus on creativity in IS research has been too narrow. They conclude that the development of a process theory which explains IT-enabled creative processes would be greatly beneficial for the field of IS and that ‘future IS research on creativity must theorise about the socio-technical context in which creativity unfolds—a challenge that will require the application of a variety of qualitative research methods in order to investigate the complex interplay of creative persons, products, processes, and (IT-enabled) contexts at the individual, group, organisational, and market levels’ (p. 235). In a more recent study, Müller and Ulrich (2013) conclude that there is still a need for

more research on creativity in the IS field, especially on the creative product and process. Furthermore, we need to develop theories explaining the role of digital technology and human actors during development in organisational contexts, how these components can shape creative and innovative solutions in a high-pressure environment to achieve a holistic understanding of the digital innovation process (Strong et al., 2014, Orlikowski and Scott, 2008, Nambisan, 2017). According to Nambisan (2017), combining theoretical perspectives (e.g., sociomateriality, technology affordance, generativity, digitalisation, etc.) allows for the joint consideration of entrepreneurial (individual, group, firm-level) constructs and digital technology-related constructs to decipher the interaction of human, social, institutional, and material agencies in entrepreneurial pursuits. This provides critical insights on ‘how digitally fuelled entrepreneurial processes unfold and on how entrepreneurs’ interactions and actions both shape and are shaped by the use of digital technologies’, which need further research in digital innovation (p. 1048).

The concept of pressure plays an important role in the discussion and research on creativity and digital innovation as the business environment is characterised as hypercompetitive (Müller and Ulrich, 2013). In this thesis, the concept of pressure is related to that which is experienced in the workplace, defined as ‘the subjective experience of substantial job demands that can be induced by internal or external forces, entail positive or negative consequences, and push an employee to behave in a specific way’ (Gutnick et al., 2012). A high-pressure environment in relation to work is defined by the Cambridge Dictionary (2020) as involving a lot of stress caused by the high expectations of others, a lot of responsibility or worry. The effects of pressure on creativity are far from consistent (Byron et al., 2010), with some studies showing that pressure kills creativity (Amabile et al., 2002, Shalley and Perry-Smith, 2001), whilst others show pressure to stimulate creative action (Gutnick et al., 2012, Baer and Oldham, 2006, Ohly and Fritz, 2010). A study by Hunter et al. (2007) shows that the environment is strongly related to creative achievement when innovation was necessary for organisational success or even survival in a high-pressure environment. They further state that there is a need for more research on the causal effect of the work environment on creativity and innovation and the maintenance of such an environment, specifically under pressure (Hunter et al., 2007). According to Gutnick et al. (2012), there is a need for more research, especially empirical studies, on why and how work pressure can impact employees’ creative performance as well as the identification of potential moderators of the pressure–creativity relationship and our knowledge of the boundary conditions of this linkage.

A suitable area for research on creativity and digital innovation is the creative industry, specifically the video game industry. As the video game industry is characterised as a hypercompetitive environment, the companies' depend on their ability to innovate, which, in turn, requires creativity (Müller and Ulrich, 2013). The creative industries are considered among the most innovative as they both support innovation in other sectors through idea generation and marketing as well as demand and push technological development (Müller et al., 2009). Lê et al. (2013) uses an example by Howard Becker (1982) to describe the relation between the creative developers and digital technology, 'Music composers generally compose for existing instruments and thus submit to the instrument's technical constraints' to exemplify that 'artistic creation does not take place in a void but is contingent upon technical aspects'. This is also relevant to computer game companies and game developers who are highly creative and skilled in a range of different digital technologies and software (e.g., 3D digital art processing packages, digital animation packages, game-world editors) used in their game development efforts (Panourgias et al., 2014, Sandovar, 2017). These tools are either off-the-shelf software products, developed in-house, or a combination of both. The choices of technology will influence the possibilities the developers have in their work. According to Zackariasson et al. (2006), creative and technological resources can represent an opportunity and a tool to gain control over challenging situations. As many computer game companies experience a high level of pressure and challenging situations, the need for creatively utilising technology to aid in the innovation process becomes imperative. Hence, the video game industry is a highly suitable area to study digital innovation as the development of videogames is based on the intertwining of creative action and digital technology, and the industry is evolving in a technologically dynamic context (Tschang, 2007, Lê et al., 2013). According to Kultima (2017) game work and game productions is as an understudied topic, which "deserves a wider understanding of how the multifaceted phenomenon of game industry as a creative industry works" (p. 45). Further, adopting a socio-technical perspective of digital innovation in game development rather than purely technical has become increasingly valuable for a holistic understanding (Kerr, 2017).

This thesis proposes a new digital innovation model of creativity under pressure. The model provides a holistic representation of how creative action emerges through the interaction between the developers and management (actor), external companies and the user base (audience) mediated by digital technology (affordance) and actualised in the production of a new artifact. Knowledge, skills, and motivation by the individual actor moderate the ability to

actualise an idea while technology (artifacts) and external actors act as both drivers and obstacles or cause of pressure in this process. Further, the thesis presents how creative action emerges under pressure on an individual and collective level. Intrinsic motivation in combination with skills and knowledge is key in enabling individuals to perceive possibilities (affordances) in the technology and environment fostering creativity, whilst collectively, technology is creatively utilised to go beyond the company boundaries to gain knowledge and resources from external actors, further fostering creative action.

Five papers form the basis for this thesis presented in table 1. Full versions of the papers are included in a collection at the end of the thesis.

Table 1 Overview of papers included in the PhD thesis

Paper	Publication venue	Status
Paper I: Patterns of Interaction Influencing Innovation in the Video Game Industry	Norsk konferanse for organisasjoners bruk av IT (NOKOBIT)	Accepted and published
Paper II: Soft Innovation in the Video Game Industry	World Conference on Information Systems and Technologies (WorldCIST)	Accepted and published
Paper III: Innovation in Game Development: IT Enablement and Affordances on Kickstarter	The Computer Games Journal	Accepted and published
Paper IV: Theorising Affordance Actualisation in Digital Innovation: The Case of the Video Game Industry	Scandinavian Journal of Information Systems (SJIS)	Accepted
Paper V: "Whoever is Educated by Anxiety is Educated by Possibility" A Study of Creativity in Game Development	The Computer Games Journal	Accepted and published

1.1 Research Question and Aim

This thesis aims to extend the current understanding of creative processes in digital innovation, addressing the role of digital technology and human actors during this process in high-pressure environments.

This thesis addresses the following research question:

How do digitally fuelled creative processes unfold in game innovation under pressure?

I set out to answer this through a case study (Yin, 2014) of video game development, which in itself is uncharted IS territory. In IS research, there are few empirical studies of the innovation process within the video game development industry (Stacey and Nandhakumar, 2009, Nandhakumar et al., 2013, Murphy-Hill et al., 2014). The video game industry is relevant to the study of creativity and digital innovation processes as it is driven by digital technologies in a highly competitive market. According to Kanode and Haddad (2009), video game development is, compared to ‘traditional’ software development, ‘unique in that it combines the work of teams covering multiple disciplines (art, music, acting, programming, etc.), and that engaging gameplay is sought after through the use of prototypes and iterations’. Whereas the main objective of software development is to enable users to ‘execute a set of tasks, determined by a clear functional objective, in a predetermined context’ (Sánchez et al., 2009, p. 66), in video game development the goal is for ‘users to achieve concrete objectives in varying degrees of effectiveness, efficiency and satisfaction, within a specific context of use’ through usability.

2. Selecting an approach

Research on innovation processes in information systems (IS) is vast and has been approached from different perspectives from management (Van de Ven, 1986), user involvement such as lead users (Von Hippel, 1986, Von Hippel and Katz, 2002), co-creation (Näkki and Antikainen, 2008), open innovation (Chesbrough, 2006), user integration (Piller and Walcher, 2006), knowledge and network (Rogers, 2003, Hansen, 1999, Benitez et al., 2017, Granovetter, 1973), and organisational perspectives (Van de Ven, 1999) to different methodologies such as systems development and agile development (Highsmith and Cockburn, 2001, Stringer, 2000). Meanwhile, the perspective of creativity in IS research has largely been ignored (Seidel et al., 2010, Müller and Ulrich, 2013). The main contributions involve research on optimal work conditions for creative employees and groups through software support, understanding human interaction with creativity facilitating systems, virtual environments, software tools, techniques,

and strategies from behavioural, organisational, and computer science perspectives (Müller and Ulrich, 2013). Less is known about how creativity unfolds in the IS development process and its relation to digital technology and innovation. As creativity is necessary for innovation to transpire, this concept should play a key role in our understanding of innovation and the relation of different influential factors during the development process. As stated by Fagerberg et al. (2006), to achieve a holistic understanding of innovation, one must combine insights from different areas, though in his book, *The Oxford Handbook of Innovation*, there is little mention of creativity. Hence, creativity could be the key to unlocking what happens inside the black-box of the organisational innovation process (Fagerberg et al., 2006). In addressing this dilemma, the 5 A's of creativity by Glăveanu (2013) is used throughout the thesis to synthesise and analyse the literature and findings. This framework is an updated version and differs from the framework of 4 P's by Rhodes (1961) in that it addresses the components *actor*, *action*, *artifact*, *audience*, and *affordance* and their relation. This is explained in more detail in Chapter 2.

Another approach that was considered was to develop a conceptual framework from theory and data, extracting concepts to structure and guide the analysis. This would involve deciding which concepts to include and which to exclude, representing the relationship between the concepts and iterating this throughout the analysis. As I came across the 5 A's of creativity framework (Chapter 2.1) quite early in the process of writing my thesis, I found that the concepts (actor, action, artifact, audience, and affordance) were well-known to me from both previous research and my papers. They aided in the identification and explanation of what I was observing in my case and in describing and illustrating the relation between each concept. I was able to build further on this framework to develop the theoretical model proposed in this thesis.

2.1 Theoretical Framework: The 5 A's of Creativity

The 5 A's framework by Glăveanu (2013) is adapted from the 4 P's of creativity model first introduced by Rhodes (1961) in his analysis of creativity. The concept of the 4 P's of creativity is considered one of the most widely used frameworks for studying creativity in psychology and includes the concepts *Person*, *Process*, *Product*, and *Press*. Couger (1993) introduced the 4 P's model to information systems theory as a means to apply creativity to an IS organisation. The model functions as a classification system for facilitating creativity and has been widely used in creativity research. Glăveanu (2013) further updated the creativity framework, replacing the 4 P's with five A's: *actor*, *action*, *artifact*, *audience* and *affordances*. He argues that this

framework can aid the researcher in changing the view from isolated components (i.e., The 4 P's framework) to an analysis of the interaction between the components. One cannot study creativity by looking at each component separately, as they are interrelated. 'Such interrelations need to be made explicit, and this is one of the first aims of the five A's model' (Glăveanu, 2013). Figure 1 shows the key differences between the two frameworks.

The four P's of creativity		The five A's of creativity	
<i>Focus on:</i>		<i>Focus on:</i>	
Internal attributes of the person	Person → Actor	Personal attributes in relation to a societal context	
Primarily cognitive mechanisms	Process → Action	Coordinated psychological and behavioral manifestation	
Features of products or consensus around them	Product → Artifact	Cultural context of artifact production and evaluation	
The social as an external set of variables conditioning creativity	Press ↘ Audience ↙ Affordances	The interdependence between creators and a social and material world	

Figure 1 Comparing the 4P's and the 5 A's frameworks found in (Glăveanu, 2013)

The framework aims to assist researchers in designing and conducting integrated research by providing a 'language of creativity' in which actors act as part of a wider environment made up of audiences, artifacts, and their affordances (Glăveanu, 2013). As I aim to understand the creative processes in digital innovation better, addressing the role of digital technology and human actors during this process in high-pressure environments, I found this framework to be a useful methodological tool to structure and analyse the information properly. For the thesis, I used the components of the 5 A's of creativity framework as nodes to analyse and synthesise each article, drawing on key characteristics of each component. It has not been used as a framework in previous articles as the idea of creative processes under pressure matured and became apparent when working on the final article (article V). It aided in providing a holistic perspective on the complexity between each component in this case, necessary to answer the research question fully and address the research gap presented in the introduction.

In the next section, I will present each of the 5 A's, *actor*, *action*, *artifact*, *audience*, and *affordances*, in greater detail based on Glăveanu's research.

Actor

The component *actor* refers to people as social beings, shaped by a sociocultural context in which they act, in coordination with others, to shape the context in suitable ways (Glăveanu, 2013). Their personal traits are seen in relation to the past, present, and future in how those traits are acquired, how they are applied in relation to others, and how they shaped and shape the social environment. A system of social relations and cultural traditions regulate these relations, and in order for individuals to create, they need to have time to internalise the rules of the group and learn and practice through action before contributing to knowledge and practices in the group (Glăveanu, 2013, Csikszentmihalyi, 1999). According to Bruner (1999), by using your capacity for reflection and for envisaging alternatives, you can escape, re-evaluate, or reformulate what the culture has to offer (Glăveanu, 2013). Creative actors factor in persuasion and investment to take advantage of ‘unusual ideas, then actively try to convince others of their value, and afterwards move on to a new ‘investment‘’ (Sternberg, 2006, Glăveanu, 2013).

Action

According to Glăveanu (2013), creativity consists of an internal, psychological dimension and an external, behavioural dimension which integrates the creative process within the broader concept of action. These are interconnected and cannot be reduced or properly understood without the other. Human creative action occurs in a context and is between actors, audiences, and artifacts. ‘Action is both psychological and material, internal and external, goal-directed, structured, and symbolic or meaningful’ (Glăveanu, 2013). Creativity is a form of goal-directed activity where the subconscious ideas and habitual actions are integrated into a broader context of acting in the world to achieve particular goals (Weisberg, 1993, Glăveanu, 2013). Glăveanu (2013) proposes that information exists neither ‘inside’ nor ‘outside’ the person but ‘in between’ actor and environment.

Artifact

According to Glăveanu (2013), artifacts are not only material but can even be perceived as an action or performance. He states that products are often viewed in isolation from the process in which they were created as well as the sociocultural context and the creator. Analysing a product can reveal its physical properties and level of novelty but disclose little of its origin and functions. The concept artifacts bring forth their cultured nature and cumulative character of creation in groups and societies. Artifacts are both material and conceptual. Hence, they exist

not only because of their physical form but through their meaning, manifested through interpersonal interactions (Glăveanu, 2013).

Audience

In Rhodes's (1961) framework, *Press* is described as the pressure of others and society influencing the creator and the work. In the five A's framework, Glăveanu (2013) divides *Press* between *audience* and *affordances* to address 'the complexities of creating in a simultaneously social and material world and relating creative actors to both other people and objects from their environment'. The concept of audience deals with social forms of press consisting of a network of actors assisting, contributing, judging, criticising, or using the creative act and/or resulting artifact(s) (Glăveanu, 2013). Creativity can be seen as an interaction between developer and audience, occurring in the context of relationships through a dialogical process (Csikszentmihalyi, 1999, Grossen, 2008, Glăveanu, 2013). Through the process of creating, a diversity of people ranging from potential collaborators and family members to opponents and colleagues and, in some cases, the wider public that will ultimately receive, adopt, or reject the creation, are involved in the activity and emergence of the new artifact (Glăveanu, 2013).

Affordances

According to Glăveanu (2013), a creative actor can 'exploit the affordances of his or her surroundings in an innovative way, to discover new affordances, and even 'create'' the ones needed to fulfil a specific action' (p. 76). The concept of affordances also applies to a business environment in which 'creative actors interact with a series of audiences at different levels of the organisation, produce numerous artifacts, both tangible and intangible—from written reports to novel solutions—and, in doing so, exploit the affordances of the physical environment—from the latest technology to conference rooms and office buildings' (Glăveanu, 2013, p.77). The objects can be used in different ways, depending on the user and the context. In the words of Gibson, 'The fact that a stone is a missile does not imply that it cannot be other things as well. It can be a paperweight, a bookend, a hammer, or a pendulum blob' (p. 134), cited in (Glăveanu, 2013). The material objects constrain or support creative action throughout the creative process and production. According to Glăveanu (2013), the developmental trajectory of creativity can be seen as starting with the ability to observe and make use of affordances in the surrounding environment, then mastering their use and altering affordances, adapting what already exists and creating new artifacts with new affordances. An actor needs to possess certain knowledge and abilities to exploit affordances fully in the environment, which

is managed over time and changes as actors discover new potentialities in their environment and shape it in desired ways.

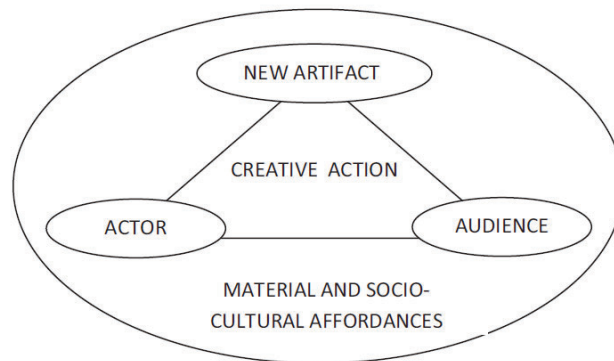


Figure 2 Integrating the 5 A's of creativity (Glăveanu, 2013)

According to Glăveanu (2013), the five components interrelate and cannot be understood in isolation. This is presented in Figure 2 above. ‘Creativity is concerned with the action of an actor or group of actors, in its constant interaction with multiple audiences and the affordances of the material world, leading to the generation of new and useful artifacts (Glăveanu, 2013, p. 76). He specifies that the framework can introduce novel areas for research and open entirely new fields of study (e.g., the role of affordances and pressure in creative action).

In an article by Lubart (2017), he argues that neither the 4 P’s (Rhodes, 1961) or the 5 A’s framework (Glăveanu, 2013) suffice in addressing the brief sketch of creativity research offered by Guilford (1967). Hence, Lubart (2017) developed the heuristic framework 7 C’s of Creativity which include the concepts: Creators, Creating, Collaborations, Contexts, Creations, Consumption, and Curricula, to capture the seven main themes in the field of creativity research. For the purpose of this thesis and study of creativity under pressure, neither the 4 P’s or the 7 C’s of creativity frameworks were sufficient for analysis. Each component is separate, similar to the 4 P’s framework and says little about the relation between each component. This relation is a vital part of the socio-technical perspective analysis. Both frameworks also do not address the element of pressure specifically. Hence, the 5 A’s of creativity framework by Glăveanu (2013) afforded me with concepts and theory which aided me in the synthetisation and analysis for this thesis.

3. Literature review

The literature presented in this chapter is categorised and synthesised in accordance with the 5 A's of creativity framework by Glăveanu (2013) (see Chapter 2) throughout the thesis.

Table 2 Key contributions in previous research categorised using the 5 A's components

Component	Key contribution	Key contributors
Actor	Digital technology facilitates creativity which involves the development of novel ideas by an individual or team and challenges the status quo. An actor's emotion and motivation are strongly connected to the level of creativity.	(Müller and Ulrich, 2013, Tiwana and McLean, 2005, Hotho and McGregor, 2013, Amabile, 2012, May, 1996, Panourgias et al., 2014)
Action	Human actors make decisions about how to respond to the tension between the action possibilities of digital technology (affordances) and their constraints.	(Henfridsson and Yoo, 2013, Rose et al., 2016)
Artifact	Digital technology affords human actors the possibility of extending the functionality of a physical product by entangling it with software-based digital capabilities.	(Yoo et al., 2010, Yoo et al., 2012, Zammuto et al., 2007).
Audience	The increased use of digital technology in entrepreneurial activity involves a broader, more diverse, and often continuously evolving set of actors with varied goals, motives, and capabilities. Creativity is often collective, moving through the development process, creating wakes of innovation.	(Tschang, 2007, Lê et al., 2013, Vogel, 2014, Boland Jr et al., 2007, Nambisan, 2017)
Affordance	Affordances are action possibilities associated with achieving an immediate concrete outcome and arising from the relation between an object (e.g., an IT artifact) and a goal-oriented actor or actors.	(Gaver, 1991, Bygstad et al., 2016, Majchrzak and Markus, 2012, Strong et al., 2014)

3.1 Actor

In digital innovation, the heterogeneous constellation of actors often constitutes the agency necessary to innovate successfully. These groups are also highly dynamic in that actors can opt in and out as goals change, new competencies are needed, motivations shifts, complementary capabilities need to be acquired, new constraints and opportunities emerge, or varying contributions become recognised (Nambisan, 2017). In a company, individual actors contribute their expertise, perspectives, and unique skills in a social team setting where each team member collaborates and builds on each other's contribution. The heterogeneity of the team members

and their expertise, work relationships, and ability to learn from one another are important factors which influence the level of creative activity in the company. Creativity is seen as ‘complex constructions involving the production, conceptualisation, or development of novel and useful ideas, processes, or procedures by an individual or group of collaborating individuals’ (Müller and Ulrich, 2013). Creativity is not limited to individuals; rather, creativity is closely linked to the context, and the interplay of individuals and their work environment (Perry-Smith and Shalley, 2014). Creativity in this highly social process can be triggered by one individual leading to collective actions or emerge through the collaboration of the team. Access to a variety of different perspectives and solutions could potentially lead to higher team creativity, given that they are relevant to the project, its context, business needs, and constraints.

When it comes to game development companies, they are dependent on a high level of creativity as well as technological savvy to compete in the turbulent and highly competitive market. Typically, the development team is heterogeneous and consists of a CEO, programmers, 2D and 3D artists, designers, writers, and a composer. It is a mixture of highly creative and technical people working together closely on a common project, that is, the game. Their goal is to develop innovative solutions not only for the game but for business processes, development tools and software to meet players’ increasing demands and is fuelled by developers’ needs and ambitions (Schreier, 2017). We see that the creative capability of people become crucial for a company’s successful innovation activity (Hotho and Champion, 2011). Previous research has shown that individual and team creativity influence the outcome of game development projects through factors such as individual’s expertise and social influence as well as individual actions and group activity (Tiwana and McLean, 2005, Müller and Ulrich, 2013). Panourgias and Nandhakumar (2014) present a view of creativity as ‘an on-going flow that, following an initial creative impulse ripples through the sociomaterial entanglements of a particular setting, reconfiguring them in the process and spreading out in time and space in often unexpected ways’ (p.122).

Cadin and Guérin (2006) state that any organisation that intends to innovate and benefit from its innovations needs to act organically to stimulate innovation efficiently, but also act mechanistically to be able to make use of its innovations. This creates conflicting interests between management and developers, where the creative dimension and routines for commercial utility collide (Hotho and Champion, 2011). Managers, therefore, need to stimulate developers’ minds and minimise hassle (Florida and Goodnight, 2005). Various encouragements, such as incentives to spark idea generation and competition, have been proven

to motivate creativity in IS organisations (Müller and Ulrich, 2013). According to Amabile (2012), extrinsic motivation is detrimental to creativity when it is imposed on them by others. While intrinsic motivation, when the actor has a personal interest and enjoyment of the creative activity, is stimulating. According to Gutnick et al. (2012), the level of the employees' goal or commitment is what shapes their willingness to invest effort and persistently work at a task leading to greater creative activity.

An under-researched yet important perspective on actors and creative action in digital innovation is their emotional state during development. Emotion being defined in the APA Dictionary of Psychology as 'a complex reaction pattern, involving experiential, behavioural, and physiological elements, by which an individual attempt to deal with a personally significant matter or event'. To understand actors creative behaviour and response in pressured situations further, we need to address research on creativity and psychology as the state of an actor's emotion is strongly connected to the level of creativity. Gutnick et al. (2012) state that pressure triggers appraisal mechanisms in actors, resulting in varying degrees of psychological states, namely challenge leading to approach-oriented motivation, and positive affect, whereas threat results in avoidance-oriented motivation, and negative affect. Threat appraisal is more complex and can undermine employee creativity or result in higher creativity as it motivates employees' sense of urgency and encourages them to seek actively new, creative ideas to solve the problem at hand. In Kierkegaard's seminal work (1980), he analysed the dual nature of anxiety as being both destructive and generative; it can lead to frustration and paralysis, but also creativity, stating, 'Whoever is educated by anxiety is educated by possibility' (p. 156). Kierkegaard regarded anxiety as an internal human condition, rather than something forced on the individual from the outside. According to Rollo May (1996), we can understand Kierkegaard's ideas on the relation between guilt and anxiety only by emphasizing that he is always speaking of anxiety in its relation to creativity. May (1996) further states that 'anxiety is the apprehension cued off by a threat to some value that the individual holds essential to his existence as a personality' (p. 189) and that anxiety of the individual fuels creativity and the enjoyment of completing challenging tasks. According to May and Gaines (1985), anxiety is the source of all creativity. It is the driving force behind human evolution, our survival and the civilisation we have today. Creativity seems to flourish in a type of *friction*; for instance, Zhou et al. (2001) found strong support for a strong association between job dissatisfaction and creativity.

Further, creativity is not limited to individuals; rather, creativity is closely linked to the context and the interplay of individuals and their work environment (Perry-Smith and Shalley, 2014).

According to Panourgias et al. (2014), creativity might be triggered by an individual, but then it ‘ripples through the resulting mesh of relations established, leading to changes and reconfigurations in both technologies and development techniques’ (p. 122). Accordingly, the creative input will be altered in the interaction with technology and developers. Understanding what occurs in this tension can lead to fruitful results in managing creative and technological development teams. In entrepreneurial research, it is shown that pursuing new ventures and actualising the possibilities accordingly will always involve both negative and positive aspects, destroying the status quo to pave the path for something new (Popova, 2018, Bullough and Renko, 2013). Understanding what drives entrepreneurial activity requires understanding how individuals personally construct perceived opportunities (Krueger et al., 2000). There is a growing need to understand how the human actor’s underlying beliefs, behaviours, and actions shape and get shaped by the collective nature of entrepreneurship facilitated by digital technologies (Nambisan, 2017, Hovorka and Germonprez, 2010).

3.2 Action

Challenges faced by small and medium-sized enterprises (SMEs), especially start-ups, relate to highly competitive markets, constrained resources and skillset, small customer base, and challenges with internationalisation (Rose et al., 2016). According to Kerr (2017) the game industry has witnessed an explosion of small companies over the past decade. These companies often rely on larger companies such as publishers to get their games to market and take advantage of new tools, platforms and channels to market and launch new types of games. As new platforms and technologies have emerged, the existing market has changed forcing established companies to adapt or perish, giving rise to new companies taking advantage of the digital era where digital online stores have become the de facto channels to market in some sectors (Kerr, 2017). In response to these challenges, the companies innovate to create value for customers, update internal development processes, and open market spaces not yet captured by the competition (Rose et al., 2016). In digital innovation, human actors make decisions—both consciously and subconsciously—about how to respond to the tension between the action possibilities of digital technology (affordances) and their constraints (Henfridsson and Yoo, 2013). In response, human actors may take advantage of the properties of digital technologies. ‘To create is to act in the world, or on the world, in a new and significant way’ (Mason, 2017, p. 7). The power of the actor to be selective and constructive in interacting with cultural material gives rise to generativity (Valsiner and Connolly, 1997). Digital innovation is often associated with the concept of generativity, which from a technology perspective, is the ‘overall capacity

to produce unprompted change driven by large, varied, and uncoordinated audiences' (Zittrain, 2006). From a social perspective, it is the capacity of a user or a community of users to generate or produce new content, behaviour, or resources without direct help from the owners of original resources (Tilson et al., 2010). Digital products sometimes evolve beyond the anticipation of their creators, which paradoxically increases their likelihood of success (Eaton et al., 2015). Furthermore, when new features are added, they may influence the existing functionality, which opens the possibility for future modifications and the continuous evolution of the digital product (Um and Yoo, 2016).

Leonardi (2011) states that constraints on organisational routines can lead to technological developments which, in turn, impact positively on the current routines. Mayer (2006) states that a set of constraints can foster creativity by shaping problems and providing clear challenges to be overcome. Creative and technological resources can represent an opportunity and a tool to gain control over challenging situations (Zackariasson et al., 2006), and pressure situations can function as 'catalysts for action', motivating individuals to address issues and problems in their environment (Gutnick et al., 2012). Creativity is a process that is aided by technology to produce content and where idea generation and modification continuously occur (Lê et al., 2013). It is a developing process and a goal executed through trial and error, observation and adjustments, shaping the goal through the means available to the actor, making discoveries through the dynamic process of creation (Joas and Kilpinen, 2007). The creative process moves in the interrelation of finding, constructing, and solving problems with feedback loops between stages, influenced by internal and external environmental and material forces that constrain or support the actions (Getzels and Csíkszentmihályi, 1976, Mace and Ward, 2002).

According to Hovorka and Germonprez (2010), when actors interact with technology, it is initiated through action or reflection. Reflection is continuous and defined by the environment and context. The technological artefact provides perceived possibilities for action which emerge as part of reflective awareness of the situated environment containing the user's goals and the technological artifact informing the actor's intentions. Reflection about the technology may lead to tinkering (Ciborra, 1992), where actors without a specific goal may alter system components and functions, leading to new artifacts and possibilities for design which then stimulate further reflection and ultimately tailoring where technology is altered to suit the actors' preferences (Germonprez et al., 2007). The development process becomes interactive involving 'innovative tinkering, tailoring, and reflection, which users apply to workarounds and unforeseen solutions to the human's problems' (Hovorka and Germonprez, 2010, p. 146).

Verjans (2005) expresses the importance of the actor's expertise and creativity in the ability to improvise or create something meaningful out of tinkering. Ciborra (1992) emphasises the importance of tinkering and serendipity in the organisational environment to increase radical learning, innovation, and the probability of 'stumbling upon' new technology. The game development process is evolutionary and complex, consisting of idea generation, multiple design iterations, and prototype testing, frequent milestones, where new features and content can be added during the development (Tschang, 2005, Bakhshi and Mateos-Garcia, 2010). A popular event hosted regularly worldwide are game jams which serve to train the social, innovation, technical, and design skills of the development team members as well as facilitating collaborative development processes (Wirman and Jones, 2019). Hagen (2004) states that borrowing ideas from other areas, such as film, can still be used in creative and innovative ways in a game and he identifies four origins of game design ideas: Ideas drawn from the game domain, ideas borrowed from narratives and visual art, ideas borrowed from human activities, and ideas borrowed from human technology and artifacts. The companies work iteratively to experiment with new ideas and produce or modify technologies necessary to deliver them (Bakhshi and Mateos-Garcia, 2010). This leads to the development of many prototypes allowing for rapid feedback on what is or is not technically feasible, showing the strengths and weaknesses of an idea (Lê et al., 2013).

3.3 Artifact

Digital artifacts offer unique characteristics as they are malleable, editable, open, transferable, etc. (Yoo et al. 2010; Zittrain 2008). Digital technology affords human actors the possibility of extending the functionality of a physical product by 'entangling it with software-based digital capabilities' (Yoo et al., 2010, Yoo et al., 2012, Zammuto et al., 2007). If the functionality is found wanting, it can be further developed to meet unfulfilled needs (Ghazawneh and Henfridsson, 2013). Thus, digital products become platforms for future development, allowing developers to extend and add to the original product, fuelling generativity and enabling complementary innovations (Boudreau, 2010, Eaton et al., 2015). Digital technologies have rendered entrepreneurial outcomes and processes less bounded, the boundaries becoming increasingly porous and fluid. 'In terms of outcomes, this relates to the structural boundaries of the product, service, etc. (for example, the features, scope, and market reach of an offering), and in terms of processes, this relates to the spatial and temporal boundaries of entrepreneurial activities (for example, when and where activities are carried out)' (Nambisan, 2017, p. 1030). The rapid advances in social media, mobile technology, and information management have

driven companies to adapt to new technological trends, which, in turn, offer access to a great amount of information, networks, and new means of collaborating and connecting with both consumers and investors; by doing so, companies can become more innovative and competitive through sharing and co-creation (Cherinka et al., 2013, Mandviwalla and Watson, 2014, Nambisan et al., 2017).

In game development, the Internet has greatly influenced the evolution of games as it can be released early in the development process and continually designed and implemented based on player feedback while playing (Nummenmaa et al., 2013). The game is a complex artifact that is technically a software program that works on a hardware platform, such as consoles, computers, or mobile phones (Lê et al., 2013) as well as a work of art that generates emotions and experiences when played by the users (Choi, 2011). Video games are more diverse interactive systems for fun and entertainment. They do not support task completion in the manner of, for example, word processors or spreadsheets but serves a different yet very specific purpose: *to make the player feel good when playing it* (Sánchez et al., 2009). The player interacts and can become immersed in the story of the game and experience ‘flow’ states when overcoming challenges with different levels of difficulty in the game (Csikszentmihalyi, 1990). This interaction and immersiveness are essential for the success of video games (Choi, 2011), and the experiential dimension of game play is, therefore, difficult to conceptualise and represent, especially in early stages of design which influences the development process as testing becomes a necessity (Nandhakumar et al., 2013, Nummenmaa et al., 2013). This is closely related to Stoneman's (2010) concept of soft innovation, which concerns changes in goods and services that primarily impact sensory or intellectual perception and aesthetic appeal rather than functional performance. The role of the user in game development has become increasingly important as they are key in understanding how the game is experienced and the level of fun it provides. The high demands from the users influence the development of the game and even push the development of technology such as development tools and platforms which further are shaped by developers' needs and ambitions (Schreier, 2017). The value of a video game is, therefore, not certain until played as an experience product (Hawkins and Davis, 2012).

3.4 Audience

The increased use of digital technology in entrepreneurial activity involves a broader, more diverse, and often continuously evolving set of actors, a shift from a predefined, focal actor to

a dynamic collection of actors with varied goals, motives, and capabilities (Nambisan, 2017). Innovation has become more open (Chesbrough, 2003) and distributed (Lakhani and Panetta, 2007, Sawhney et al., 2005). A commonality in game development environments is ‘collaboration across organisational and industry boundaries, and among groups and individuals with disparate forms of specialist expertise, with creativity becoming consequentially more widely distributed across these boundaries’ (Panourgias et al., 2014). According to Svahn et al. (2017), for firms to embrace digital innovation, they must reach out to external ecosystems by providing ‘generative products to stimulate development of new configurations and possibilities through an ongoing transformative process’ (p. 248). Creative activity is found in the dynamics between actors’ creative knowledge and expertise and their collaboration with experts in other fields (Panourgias et al., 2014). By leveraging cooperation with external companies by harnessing the power of the environment, companies can co-evolve their capabilities and roles to create additional value (Williamson and Meyer, 2012). Technology, besides being a target of innovation, can facilitate increased knowledge distribution across boundaries, further enabling new knowledge to be created and distributing it in new ways (Boland Jr et al., 2007). The combination of supportive and challenging environments sustains high levels of creativity in individuals and teams. Organisations can actively induce supporting atmospheres on the same line as hindering creative and innovative activities (Vogel, 2014). In a study by Boland Jr et al. (2007) on the adoption of digital three-dimensional (3-D) representations in the building projects, diffusion of innovation is presented as wakes and intersecting paths, a landscape of ‘autonomous, vibrating nodes that create complex sets of connections from relatively simple interactions taking place in their trading zones’ (p. 643). Specifying the need to explain ‘diverse actors’ individual innovations, as well as how those actors and their activities are interrelated and produce wakes of innovation spreading beyond the boundaries of their communities’ (p.634).

Customer interaction is now an important contribution to new product development as it leads to the positive outcomes of innovation initiatives, greater quality, and lower cost (Von Hippel, 1986, Carbonell et al., 2009, Magnusson et al., 2003, Pöppelbuß et al., 2011). Many companies have realised the value of integrating social media capabilities into their IT infrastructure in order to capture and utilise the data and knowledge of their user bases (Benitez et al., 2017). Many social media platforms are interactive, open, widely available, commodity-like platforms ‘which afford openness and flexibility in bringing separate user experiences together; enabling social connectivity and monitoring of this connectivity; and allow for broad transparency and

traceability of user content' (Jarvenpaa and Tuunainen, 2013). A critical part of video game development is user testing as the games are interactive artifacts, and consumer satisfaction and technical performance are not established until tested by users (Bakhshi and Mateos-Garcia, 2010). However, many authors have analysed the difficulty of getting good information on customer needs for innovative products in potential markets because customer preferences may not be known by the customers themselves (Balachandra and Friar, 1997). A study by Banks and Potts (2010) of the game development company Auran, explored the relationship between the developers and the game players and testers who provided extensive feedback and design input. The study illustrated the immense influence the players can have as actors in a co-producing role with the developers as well as the challenges that emerge in this complex relationship in relation to market and culture. They presented a need for more integrated models of human action and co-evolution in consumer participation and innovation during development (Banks and Potts, 2010). Hagen (2011) state that there are challenges in communicating the vision for a game for player experience and presents design practises and tools from game developers to express the experience the games should mediate. The research showed that the design is more often based on the designers' own experience instead of the actual player, which can pose a challenge when expanding to target groups outside of their own target group. Hagen (2011) concludes with the need to understand smaller studios work with player experience. Social media platforms can aid in this interaction and communication with players, though there are few studies on the influence of user knowledge on specific innovation activities or on the ways by which IT platforms, specifically social media platforms, support these activities and generate business value (Sawhney et al., 2005, Pöppelbuß and Malsbender, 2013, Blazevic and Lievens, 2008, Benitez et al., 2017, Magnusson et al., 2003).

3.5 Affordances

The concept of affordances is familiar to psychology, industrial design, and human-computer interaction and was first introduced by the psychologist Gibson (Zittrain, 2008, Gibson, 1979). Gibson (1979) presented the concept of affordance as a reality that does not 'belong' to the animal or the environment alone but to their interconnection. He argued that the affordances are relational features offered by an object in terms of human action. Affordances are action possibilities 'associated with achieving an immediate concrete outcome and arising from the relation between an object (e.g., an IT artifact) and a goal-oriented actor or actors' (Bygstad et al., 2016). According to Gaver (1991), affordances present a special configuration of properties, and the attributes of the object are compatible with the actor and perceived by the actor who

acts upon the object. Majchrzak and Markus (2012) argue that affordances and constraints are neither properties of people nor technology but should be viewed as potential interactions between people and technology. Thus, affordances emerge through the interaction between technology and human actors and are not features of a technology. Affordances exist as a relationship between a knowledgeable human actor and a technology, and it may be interpreted as the coming together of needs (human actor) and capabilities (technology) (Bygstad et al., 2016). The affordance theory offers a promising lens particularly well suited to help IS researchers build new theories on digital innovation processes and the outcomes (Nambisan, 2017).

‘Affordance theory takes a socio-technical perspective that lets us be specific about the technology while simultaneously incorporating social and contextual elements’ (Volkoff and Strong, 2017, p. 2). From a socio-technical perspective, the social subsystem includes structures and human actors, whereas the technical subsystem includes technology and tasks, and the relationship between the subsystems are particularly important in understanding the influence and impact of the larger socio-technical system (Bostrom and Heinen, 1977) and how the subsystems act as moderators (Sarker et al., 2013). As stated by Strong et al. (2014), it is assumed that human actors have the requisite abilities and means to effectively actualise available affordances, although this is not always the case. Users may not possess the knowledge to engage in the process, and the technology may be faulty. Such factors affect whether the affordance is actualised fully, partially, or not at all (Volkoff and Strong, 2017). The socio-technical context enables or constrains the actualisation of the affordance (Bygstad et al., 2016). In digital innovation, human actors make decisions—both consciously and subconsciously—about how to respond to the tension between affordances and constraints (Henfridsson and Yoo, 2013). In response, human actors may take advantage of the properties of digital technologies. Digital technology affords human actors the possibility of extending the functionality of a physical product by ‘entangling it with software-based digital capabilities’ (Yoo et al., 2010; Yoo et al., 2012 p.1; Zammuto et al., 2007). If the functionality is found wanting, it can be further developed to meet unfulfilled needs (Ghazawneh and Henfridsson, 2013). Thus, digital products become platforms for future development, allowing developers to extend and add to the original product enabling complementary innovations (Boudreau, 2010, Eaton et al., 2015). As human actors interact with the technology, they become aware of the affordances and constraints that support and hinder them in reaching their goals (Van Vugt et al., 2006). Digital product have the potential of evolving beyond their creators anticipations increasing their

chance of success (Eaton et al., 2015). Furthermore, the continued evolution opens the possibility for future modifications (Um and Yoo, 2016).

The actors are also situated in an organisational context which influences their goals and their actions. Such factors affect whether the affordance is actualised fully, partially, or not at all. Hence, the socio-technical context enables or constrains the actualisation of the affordance (Bygstad et al., 2016). As game development start-ups often experience turbulent times, they need to be creative and resourceful in their work. Greg Satell wrote in Forbes (2014) that digital technology enhances creativity by its plasticity and its ability to recombine. The result, as we can see in most creative industries, is a wave of innovation. Game development processes differ from typical information system or software development process situations as there is a higher level of flexibility, and they are more open-ended in their content creation (Lê et al., 2013). Leonardi and Barley (2008) hypothesise that features of technology act as both affordances and constraints on user behaviour. Furthermore, they explicate the importance of understanding the socio-technical context of work practices and organisational changes in which social and technical aspects are viewed as both separate and interdependent (Volkoff and Strong, 2017). Technology is both a product and mediator of human action, which is further shaped by the organisational context. The actions of humans interacting with technology affect structural properties of organisations (i.e., social or technological) either by reinforcing or transforming them (Orlikowski, 1992). Thus, ‘affordances for organising depend not only on the functionality characterising the information technology but also on the expertise, organisational processes and procedures, controls, boundary-spanning approaches, and other social capacities present in the organisation, implying their essentially sociomaterial nature’ (Sarker et al., 2013, p. 14). Strong et al. (2014) specify the lack of theory on (1) the process of actualising an affordance’s potential, (2) affordances in an organisational context, and (3) affordances that arise in the form of a bundle of interrelated affordances. Further, they identify three factors (abilities and preferences of the individual, features of the system, and characteristics of the work environment) that both support and constrain an individual's affordance actualisation (cited in (Anderson and Robey, 2017)). They encourage future studies to examine how the relationship between human actors, the organisation, and technology influences change through affordance actualisation.

4. Research Methodology

This chapter describes the case, research approach, research methods, and strategies as well as ethical considerations.

4.1 Research Site: The Norwegian Video Game Industry

Compared to the global gaming industry which generated approximately \$135 billion in 2018, the Norwegian video game industry had an estimated value of \$328 million in 2018 (Research and Markets, 2019, Dobrilova, 2019). The video game industry in Norway is small and young, with an increasing number of start-up companies that fight to survive and become successful. There is estimated about 100 active game development companies in Norway with a varying degree of production and revenue. Many of these are not 'pure' computer game companies, meaning they do work-for-hire and other projects outside of game development. There is uncertainty about the number of employees in the Norwegian gaming industry. Figures from Proff Managed sum up to 610 employees, though there are several companies excluded from this calculation. The majority of companies are small, with less than ten employees, where only five companies have more than 20 employees. The average age of employees in the Norwegian game industry is 30-39 years with 70% that have a higher education level similar to Bachelors degree (Kulturdepartementet, 2018). Most of the companies were established over the last decade, with a spike in the number of new companies in 2012 and 2013 (Kulturdepartementet, 2018). In 2016, 11 companies had a profit of more than NOK 1 million, with three of the companies having a profit of more than NOK 5 million. More than half of the companies had a negative result, which may be partly due to the fact that there are many start-ups, which often have negative results in the first few years (Kulturdepartementet, 2018). Overall, the game developers in Norway have experienced strong revenue growth from 2017 to 2018. Revenue growth is due to growth in established companies as well as new companies that have joined. Solid revenue growth between 2017 and 2018 indicates that the industry is growing. At the same time, the turnover of the companies will vary considerably between years. The development and production runs for games are long, in average 2 - 4 years (Virke, 2019). The increase in the number of companies is a result of industry veterans as well as newly educated developers establishing indie companies (small independent companies without significant financial support of a video game publisher or another outside source) with their own productions.

The most innovative part of the industry is the smaller firm and start-ups, often with only one product, and with young and enthusiastic developers and owners. It is well known that the odds for success are high and that many of them will struggle for years or go bankrupt. With such rapid growth, it becomes evident that competition for market establishment increases and so does the need for new and innovative ideas, which are crucial to a company's survival (Fagerberg et al., 2006). The development practices and processes have been influenced greatly by the digital revolution (Bakhshi and Mateos-Garcia, 2010). The ability to distribute games in digital form across sales platforms such as Steam, App Store, and Google Play lowered a significant barrier for developers to reach the market, providing start-up companies with more opportunities to compete in the market. PC and console platforms experienced an accelerated rate of technological change, such as processing power, peripherals, and user interface, and the market has grown, especially for so-called 'indie' games, games developed by smaller and independent developers. New genres and business models emerged on mobile platforms, and so-called 'free-to-play' games emerged (Kulturdepartementet, 2018). In a small market like Norway, creating their own distribution and publishing platform is vital as many games are published in Norwegian and thus do not reach the international market. Norwegian game developers rely on Internet distribution as it supports national and international reach, enabling them to achieve a greater income and become self-reliant (Jørgensen, 2013). This results in more control over the distribution and ownership of the company and their product (Jørgensen, 2009). New funding platforms such as crowdfunding through Kickstarter (Kickstarter, 2014) and early access on Steam (Steam, 2014) provide sources for additional income as well as verification from users and the market throughout the development process. As video games are played by a wide variety of people in all age groups, the potential market for both distribution and investments are high. In a report by the entertainment software association (ESA, 2019) 65% of American adults play video games, 46% of these are female with an average age of 34 and 54% are male with an average age of 32. The most common devices used for game play are 60% on smartphone, 52% on PC and 49% on game consoles. From the EU's population aged 6-64, 54% play video games which equates to some 250 million players in the EU alone (IFSE, 2020). The gaming industry has a worldwide turnover of NOK 1,230 billion in 2018. This means that the Norwegian gaming industry's gross turnover represents 0.04 per cent of the global game industry (Kulturdepartementet, 2019).

There are Norwegian funding agencies that gaming companies can use that are largely limited to grant and support schemes within the cultural field and that are provided in connection with

game development. The most important administrators of support schemes used by gaming companies are the Norwegian Film Institute, Innovation Norway, and SkatteFUNN (Kulturdepartementet, 2018). One of the main public funding organisations, the Norwegian Film Institute (NFI), operating under the Ministry for Culture, provides as much as 75% funding for game development or NOK 200.000 to NOK 400.000 as long as the product meets three of the four criteria for a cultural product (NFI, 2019). NFI provides support after the development of the game has begun and a concept, graphic, or demo of the game can be presented (Kulturdepartementet, 2018). NFI feels that the gaming industry has a significant need for the support schemes they manage and have conveyed a desire for more leeway to support game development (NFI, 2019). The employees do not meet employees with professional understanding and knowledge of the industry in NFI because approximately only one full-time-equivalent (FTE) of its 81 employees works with games, while the rest are working with film (NFI, 2019). Another financial actor is Innovation Norway, which is currently the agency gaming companies often turn to for additional and more market-oriented support. Innovation Norway has various schemes that contribute to innovation and the development of competitive enterprises in the Norwegian sector (Jørgensen, 2013). Together, these two organisations provide game development companies with enough capital to begin production, though not enough to become self-reliant. This requires a sustainable income and investments and is a great struggle for many game developers. Though there are financial challenges for the companies, the amount of video games being launched and are succeeding in the international market have bloomed along with the increase in new companies. An overview of a few of the successful games developed in Norway are presented in table 3 below.

Table 3 Overview of select games developed in Norway

Norwegian game	Game genre	Platform	Company	Release year
Angel Adventure	Adventure	PC, iOS	Ravn Studio	2008
Age of Conan: Rise of the Godslayer	Massively multiplayer online role-playing game (MMORPG)	PC	Funcom	2010
The Secret World	Massively multiplayer online role-playing game (MMORPG)	PC	Funcom	2012
Fun Run	Platform game	Android, iOS	Dirtybit	2012
Teslagrad	Puzzle game	PC, OS X, Nintendo Switch, Wii U, PS3, PS4, PSVita, Xbox One, Android, iOS	Rain Games	2013
Among the Sleep	Action-adventure games	PC, PS4, Xbox One, Nintendo Switch	Krillbite Studio	2014
Trolls vs Vikings	Strategy game	PC, Android	Megapop Games	2014
Dreamfall Chapters	Adventure game	PC, PS4, Xbox One	Red Thread Games	2016
Owlboy	Platform-adventure game	PC, MacOS, PS4, Xbox One, Nintendo Switch	D-Pad Studio	2016
Through the Woods	Adventure game	PC	Antagonist	2016
Earthlock	Role-playing game (RPG)	PC, OS X, PS4, Xbox One, Wii U, Nintendo Switch	Snowcastle Games	2016
Draugen	Adventure game	PC, PS4, Xbox One	Red Thread Games	2019

The choice of focusing on start-up companies in this case study was sensible as it represents a large part of the Norwegian video game industry. Start-up companies are defined as new and small businesses designed to create new products and services under conditions of extreme uncertainty and are accompanied by high innovation-driven growth (Ries, 2011). I therefore expected the Norwegian game start-up companies would face more challenges and have a higher need for creative and innovative solutions than large, established companies. It was expected that this would provide me with a greater number of case examples of developers' use of digital technology during the innovation process and an in-depth account of how the innovation process unfolds.

4.2 Case selection

The study involved six game development companies in Norway as well as governmental institutions connected to the industry during the period 2013-2018. The cases were selected from a replication perspective (Yin, 2014); that is, they were expected to reveal the same patterns. This was when the focus of the study was on the innovation process before the concepts of affordances and pressure were introduced in papers III, IV and V. The selection criteria were that the case (1) was an active game development company with (2) success in the video game market. Active in this context was defined through information from the Brønnøysund Register, a Norwegian government digital register, the Norwegian Film Institute (NFI), and Joingame, a national resource network funded by the Norwegian Research Council. This provided an indication of funding amount, times funded, years active, and profitability. By crossing the data, a list of the most active companies with a positive income was generated. The top 10 companies were contacted with information about the project, and six were interested in participating in an interview. From these six, three of the companies provided on-site access to the company and their employees. Because of location, only two were visited more than once, and one company (Company F) had a personal interest in the study and allowed me to follow them closely for three years. This company became my main case, providing me with in-depth information into their development process, roles and network over time. This enabled me to obtain a holistic study focusing on the complex network and their interconnections (Oates, 2006). The information from the five other companies were then used to compare the information provided by company F and provide further insight. No interviews were conducted with developers at the companies A-E though questions were asked during the observations relating to their work. What characterises these companies is that they are small and mainly start-up companies. They develop different types of games, such as adventure, role-playing games (RPG), strategy, and platform games, and they address different markets, such as mobile, console, or PC. The main development platform used was Unity, except for two companies that used platforms developed in-house.

Table 4 Interviews and documentation of the companies

Company	Interviews	Documents	Roles
A	2	Observation notes, documents	CEO, Creative Director
B	1	Blog entries, documents	CEO
C	1	Observation notes, documents	CEO
D	1	Documents	CEO
E	3	Documents	Project Manager
F	20	Observation notes, documents, data from social media	COO, CEO, programmers, 2D and 3D artists, designers, graphic designers

4.3 Research approach

The two most common research approaches are quantitative and qualitative research. According to Creswell (2009), a qualitative approach is one in which the researcher often uses strategies of inquiry such as narratives, phenomenology, ethnographies, grounded theory studies, or case studies. The researcher collects open-ended, emerging data with the primary intent of developing themes from the data. For this research, a qualitative method using a case study approach was appropriate. It enables the researcher to investigate themes deeply, apply interpretations, and create connections between the data. In popular discussions, qualitative method has been questioned if it leads to indiscriminate data collections and data overload (Miles and Huberman, 1994). To minimise such situations, I was transparent with the key informants and provided them with the papers before publication (see more Ch. 4.6). For each paper, specific methods to process and analyse the data were carefully used to ensure good-quality data.

‘In the conduct of scientific research, the actions of researchers are guided by the systems of belief by which they generate and interpret knowledge claims about reality’ (Wynn Jr and Williams, 2012, p. 788). The assumptions about knowledge and how it can be obtained is referred to as epistemology (Myers and Avison, 2002). In information systems research, one has three underlying epistemological camps which guide one’s qualitative research, as illustrated in Figure 3.

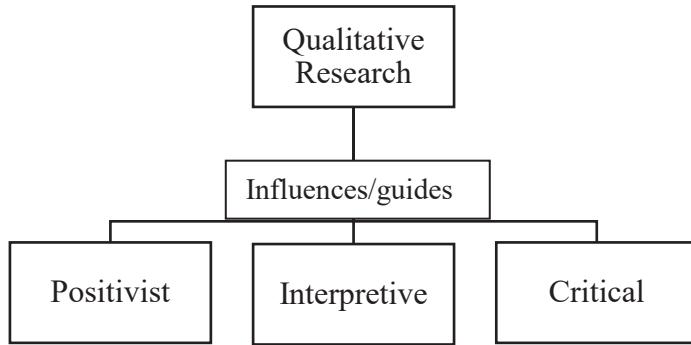


Figure 3 Underlying philosophical assumptions (Myers and Avison, 2002)

Though I do reference Yin as a source for case study research, I am aware that Yin leans towards positivist case study, whereas I began my research with an interpretive perspective mainly focusing on an in-depth, longitudinal case study of one company, the aim being to interpret other people’s interpretations (Walsham, 2006). A case study is an empirical inquiry investigating a contemporary phenomenon in a real-life context, and focuses on in-depth information, a holistic view of relationships and processes, and uses a wide range of data sources (Oates, 2006). I have also followed Maxwell’s (2013) process orientation perspective for the case study where researchers ‘tend to see the world in terms of people, situations, events, and the processes that connect these; explanation is based on an analysis of how some situations and events influence others’ (p. 29). They ‘tend to ask *how* *x* plays a role in causing *y*, what the *process* is that connects *x* and *y*’ (p. 31). In doing so, I gradually evolved my perspective towards critical realism. As presented in Table 3 below, each paper has either an interpretive or critical paradigm. The reasoning for each paper is presented in Table 3. My theoretical perspective gradually progressed towards the critical realism paradigm as I came across and included the affordance theory in my research to understand further the influence and relationships between human actors and digital technology in an organisational context and the mechanisms to explain these interactions. Mechanisms connect chains of unspecified events and complex interactions, allowing the researcher to ‘develop and support in-depth causal explanations for the outcomes of specific sociotechnical phenomena that take into account the breadth of information technology, social, organisational, and environmental factors which may have played a causal role in their occurrence’ (Wynn Jr and Williams, 2012). Critical realism offers a framework which uses different methods to gain a better understanding of the role of information systems in the contemporary world (Mingers et al., 2013) and acknowledges the role of subjective knowledge of social actors in a given situation and how their actions are enabled and constrained by independent structures in a particular setting (Wynn Jr and

Williams, 2012). As an empiricist, ‘only that which can be perceived can exist, whereas for a realist, having a causal effect on the world implies existence, regardless of perceptibility. This view of causal mechanisms is at the heart of critical realism’ (Mingers et al., 2013, p. 2).

Moving from empirical descriptions to potential causal mechanisms, observable or non-observable, is an essential methodological step in critical realist studies (Mingers et al., 2013). By describing detailed processes of events generated by structures, actions, and contextual conditions involved in a particular setting, one shifts the focus towards causality (Wynn Jr and Williams, 2012). These causal powers, tendencies, or ways of acting refer to ‘generative mechanisms’ (Mingers et al., 2013). The goal is, therefore, to *explain* the mechanisms that generate a certain event more than the ability to *predict* future events or to *understand* the social/cultural meanings behind the events (Wynn Jr and Williams, 2012).

Table 5 Paradigms and approach for each paper

Paper	Paradigm and approach	Reasoning
Paper I: Patterns of Interaction Influencing Innovation in the Video Game Industry	Interpretive case study	To understand the challenges Norwegian game companies faced
Paper II: Soft Innovation in the Video Game Industry	Systematic interpretive literature review	To understand the role of soft innovation in game development
Paper III: Innovation in Game Development: IT Enablement and Affordances on Kickstarter	Critical realism case study	To identify causality for innovation through the developer- user relation on social media platforms
Paper IV: Theorising Affordance Actualisation in Digital Innovation: The Case of the Video Game Industry	Critical realism case study	To identify mechanisms to explain the affordance actualisation process
Paper V: ‘Whoever is Educated by Anxiety is Educated by Possibility" A Study of Creativity in Game Development	Interpretive case study	To understand how emotions influence creativity

4.4 Research method

Data was collected over five years, from 2013 to 2018. In each case, three types of data were collected; in-depth interviews, observation notes, and archival documentation. The interviews were conducted at the premises of the company, lasting one hour on average. The interviews were semi-structured, allowing for additional questions to be asked outside of the prepared questions, providing greater detail and depth in the information from the informant. The informant can introduce issues they find relevant to the conversation (Oates, 2006). Events and conferences, such as Joingame and SpillExpo, were attended for networking purposes which provided an arena for discussing observations and results made during the study with developers and other experts from the Norwegian game industry. These provided additional insight as well as verifying information from the interviews. Observations were overt where the developers had agreed to be observed, and I was allowed to ask questions in the given situation. The observations were of daily work activities in an open space environment.

4.5 Data Analysis

Data were analysed following Miles and Huberman (1994) interactive model (Figure 4) through coding and data displays. According to Miles and Huberman (1994), data displays are analytic activities which can be used for data reduction. It gives the ability to assemble information into an immediately accessible, compact form so that the analyst can see what is happening and either draw justified conclusions or move to the next step of the analysis that the display suggests may be useful. Following the interactive model, the researcher goes through three stages of analysis and an activity of data collection, which form an interactive, cyclical process. One moves between the four nodes during data collection and then shifts between reduction, display, and conclusion drawing/verification for the remainder of the study. Coding the data during data reduction was done using Nvivo software where different themes were identified, which lead to new ideas on what information should go into the data display. In Nvivo, one uses nodes to categorise and further display the data. Entering the data requires further data reduction. As the nodes fill up, preliminary conclusions are drawn and can lead to the decision, for example, to add another node or to test the conclusion (Miles and Huberman, 1994).

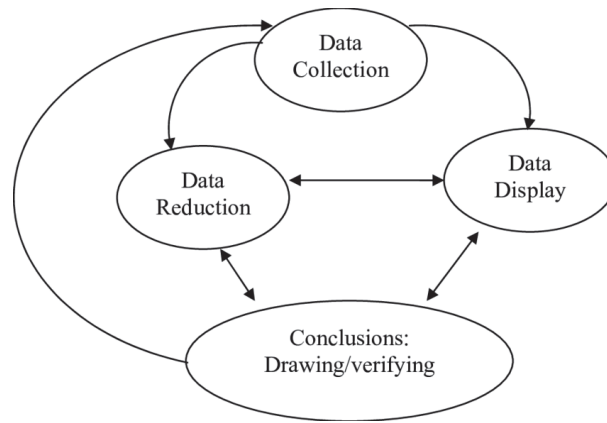


Figure 4 Interactive model for data analysis (Miles and Huberman, 1994, p. 12)

Using the 5 A's framework for analysis and synthesis of the five papers this thesis builds on provided me with a structure in which I could manage the large amount of information. The framework aims to assist researchers in designing and conducting integrated research by providing a 'language of creativity', in which actors act as part of a wider environment made up of audiences, artifacts, and their affordances (Glăveanu, 2013). As I aim to understand the creative processes in digital innovation better, addressing the role of digital technology and human actors during this process in high-pressure environments, I found the components of this framework to be a useful methodological tool to structure and analyse the information properly. I used the components of the 5 A's of creativity framework as nodes for coding and structuring the data, drawing on key characteristics of each component. In the process of analysing each paper, I did a within-case analysis where I decontextualised the information of the papers using the 5 A's framework to extrapolate key findings for each component. This resulted in a table for each paper. Within-case analysis alerts the researcher to the presence of key elements, understanding the individual account in its own context, and developing a synthesis that captures the essence or variation of experience across individuals (Ayres et al., 2003). Further, I compared each table to identify similarities and differences, synthesising the papers and recontextualising the findings as key contributions. This is presented in Table 9. The recontextualised data create a reduced data set drawn from across all cases (Ayres et al., 2003, Tesch, 2013). I then use the reduced data set to move from empirical to theoretical description by further discussing the case in relation to the contributions and previous literature in the context of creativity and pressure and how they relate to digital innovation. A challenge met in analysing the papers using the 5 A's framework was that the process of deduction requires the researcher to focus on certain aspects of the data while excluding others, which calls into question the validity of the conclusions drawn from the reduced data. In this thesis, this was

managed by moving back and forth between the tables, the categorised information, and the full papers during analysis to confirm and deepen the understanding of the results and conclusions drawn. The resulting conclusions are also linked with data excerpts in the form of quotes to provide the reader with a deeper understanding and support the final conclusions (Miles and Huberman, 1994).

4.6 Ethical considerations

Though the companies were chosen through a replication perspective, it is important to note that I have provided the key informants with samples of the articles for review before publication, not only as a courtesy but to make sure the information has not been misinterpreted or misconstrued. This has also been a part of the validation process and served to balance the perspectives of the participants of the case (Yin, 1981). Each informant signed consent forms before I began the interviews and were anonymous (unless agreed otherwise) and they could withdraw at any time. NDAs were also signed with the companies. The project has been reported and approved by the Norwegian Data Protection Services (NDS).

5. Findings and analysis

In this chapter, I synthesise the five papers using the 5 A's framework to answer the research question '*How do digitally fuelled creative processes unfold in game development under pressure?*' First, I go through each paper separately; then I summarise at the end to a coherent whole. This shows how the papers relate and build on each other.

The papers were written over five years, during which I developed my perspective and adopted the concepts of affordances and actualisation to explain the creative actions of the game developers leading to innovative outcomes. The first paper presents a holistic view on the interactions between actors and technology in game development and was my initial attempt to get an overview of the Norwegian game development industry. The second paper presents the concept of soft innovation. I found this concept important to include as video games are experience products, combining digital technology and art, highlighting the importance of a soft and hard perspective on innovation. The third paper presents the concept of affordances and how digital platforms can afford innovative solutions by collaborating with the userbase. These three papers form the basis of paper four, showing the actualisation of affordances in digital innovation during game development and connecting the concepts and perspectives.

Finally, paper five introduces the concept of creativity and pressure forming emotional responses of worry and anxiety to address the creative action of the individual developer and the firm during development. This paper builds on the data and examples used in the four previous papers.



Figure 5 The evolution of the papers

5.1 Paper I: Patterns of Interaction Influencing Innovation in the Video Game Industry (NOKOBIT, 2014)

Abstract: *The video game industry is a highly creative and fast-paced industry where innovation is a necessity to stay ahead. The innovation processes in the video game industry are not rigorously explored and often treated like a 'black box'. Much attention has been towards game design and function, on the product innovation, not on the process. In this paper, patterns of interaction supporting innovation in the video game industry are investigated through an engaged scholarship approach through interviews and observations with video game companies and informants in Norway. The findings show that there are four identifiable patterns of interaction influencing the innovation process by reinforcing or hindering it. By understanding how the complex video game industry environment and its actors interact, the company can increase its innovation capability and thereby its competitive advantage.*

Table 6 Key findings in Paper I using the 5 A's framework

Component	Key contribution
Actor	The developer's characteristics such as self-driven, experimental, creative, technical, flexible, and with a high level of intrinsic motivation, supported by the organic process and flat structure where knowledge and skills are shared within and across boundaries enable creativity and innovation.
Action	Organic process without an innovation goal but focus on learning from others' dos and don'ts.
Artifact	Digital technology enables developers to interact with external actors and develop novel technology. However, regulations and standards in platforms can hinder innovation.
Audience	Video games are interactive artifacts dependant on user testing to indicate what works and what does not. Digital technology enables testing and communication with external actors.
Affordances	Shortcomings in technology, as well as new technology, can foster new solutions, and flexible solutions can counter rapid technology development.

Actor

In this paper, the different roles of management, producer, programmer, artist, designer musician, and tester represent the component actor. The key findings reveal that, for small companies, one person could inhabit multiple roles and management often encouraged employees to acquire knowledge and skills from different areas and experiment with resources in their environment. This process is flexible, enabling interpretation and individuality from each member of the team, fostering creativity and innovation. However, balancing flexible and rigid management is important to avoid miscommunication and interpretation leading to

undesirable outcomes. Management facilitated their work process through clear goals, which were adjusted in each iteration to adapt to the changes and new knowledge gathered. The developers with previous experience were highly self-driven, while the newly educated developers were more uncertain in their role. The artists showed greater difficulty organising and needed to be more tightly managed. The developer's characteristics such as self-driven, experimental, creative, technical, flexible; and having a high level of intrinsic motivation were supported by the organic process and flat structure where knowledge and skills are shared within and across boundaries enable creativity and innovation.

Action

In this paper, the component action involves observing market trends and the success and failure of other companies in order to gain new knowledge and information which feeds into the development process and can ultimately lead to a creative outcome. As the market moves quickly, it becomes important to pay attention to what works, how it works, and understand why it works to gain competitive advantage. An interesting observation made during the interviews was that most of the companies did not express a clear innovation strategy or goal. They stated this was inherent in their culture and considered to 'just happen'. When asked about their approach towards innovation, a common answer was: *'We do not have a goal to innovate, but we do it anyway'.*

Artifact

In this paper, the component artifact is related to the use and development of technology in novel ways and to create value for the company. With the rapid development of consoles and development platforms, the companies experience pressure to keep up. This is discussed in greater detail under affordances. In a small market like Norway, creating their own distribution and publishing platform is vital as many games are published in Norwegian and thus do not reach the international market. This results in more control over the distribution and ownership of the company and its product. New funding platforms such as crowdfunding through Kickstarter and early access on Steam provide sources for additional income as well as verification from users and the market throughout the development process. Digital platforms have created new ways for companies to interact with other actors. These provide an environment for companies to share experiences, technologies, and financial support. However, regulations and standards set by the platforms can hinder the development of innovative games.

Audience

In this paper, the component audience relates to user interaction and knowledge sharing among companies. Involving users as part of the development process can ensure to some degree the success of the game in the market as video games are interactive artifacts, and consumer satisfaction and technical performance are not established until played by users. This can be managed through tests, such as alpha and beta tests, which provide indicators of what works and what can improve in the game. Digital platforms have enabled new ways for companies to interact with users through social media, forums, and company websites. However, these arenas are mostly a one-way street where users provide information, and the companies collect what is of relevance as defined by the companies themselves. For this type of information to become useful for a company, a large amount of time and resources needs to be dedicated to gather and analyse the data. This is not always profitable, and the data is not always reliable.

Findings in this paper also show there is a strong collaborative culture in the game industry, both internally in the company as well as externally. In the Norwegian game developing industry, companies and individuals share knowledge, technology, and resources to strengthen the growing industry.

It is also demonstrated that a great number of the Norwegian game development companies, especially start-ups, are reliant on external funding to finance their projects. Public governmental funding programs from institutions such as NFI and Innovation Norway are meant to cover the initial start-up phase of a project, from idea to finished prototype. To fund the remainder of the project to release, the companies need to invest time and resources to raise capital through private investment and external investors. These governmental aids have certain criteria that need to be met, such as cultural influence or distributing the game in the native language in order to receive funding. This can make it difficult to reach international markets. These policies can, therefore, hinder innovative productions necessary for the industry to strengthen and grow. A solution could be alternative distribution and publishing channels. Also funding through alternate channels such as Kickstarter can provide the necessary capital to publish the games. This requires many resources and much time to market the potential game to users, yet there is no guarantee of the success of the campaign. This can greatly halter the development process and even kill a project.

Affordances

In this paper, affordances relate to the interaction between developers and technology and how technology can support or hinder development. With the rapid development of console and development technology, new standards are introduced quicker than the production of one possible game, consequently forcing the game development company to adjust accordingly or risk losing their market position. Findings show they invest in a 'platform product' which is suitable for their purpose and create modules to customise its use. This occurs provided the standardised platform is flexible at its core, allowing external modules to interact. In this case, platform providers can hold dominant positions in the industry, but they also face the challenge of managing the evolution of the platform by cultivating an effective ecosystem of enablers and complementors. Findings show that the game development companies adjust to this evolution through a combination of standardised platform technology and technology developed in-house by the company. This provides the flexibility necessary to adjust to changes in external technology as well as keeping stability in the development tools, that is, shaping the modules surrounding a stable core of the system.

5.2 Paper II: Soft Innovation in the Video Game Industry (WorldCIST, 2018)

Abstract: *This paper reviews literature on soft innovation with a focus on soft innovation in the video game industry. A systematic review of books, reports, and papers – in all, 39 literary works – forms the bases of this paper. Four streams were identified from the literature, management, design, market, and network. Based on the findings, some key insights were made: A holistic view of hard and soft innovation is necessary; the product becomes valuable only through experience; the market pressure increases the need for soft innovation, and networking increases knowledge, which generates intangible and tangible value.*

Table 7 Key findings in paper II using the 5 A's framework

Actor	Combining internal innovative resources with external input increases intangible knowledge, and deep industrial knowledge is essential.
Action	Experiential marketing aids in understanding the customer experience, and 'idea harvesting' and user-testing are important tools in the development process. The innovation process includes interaction, feedback, and problem-solving (learning).
Artifact	Video games are experience products where it is difficult to separate content innovation from technical innovation.
Audience	As the games are experience products, it is essential to involve users early and collaborate with external institutions and firms to increase innovative ideas and knowledge.
Affordances	New technologies present new opportunities for innovative solutions. Changes to content and features can alter the game play dramatically, influencing the user experience.

Actor

In this paper, the component actor focuses on the role of management, specifically managing soft innovation that involves culture and knowledge management, managing networks, new strategies or marketing concepts, relationships with other companies or users, as well as managing the production of content. By combining internal innovative resources with external inputs such as educational institutions, companies, consumers, or competitors increases tangible and intangible knowledge of the employees. Deep knowledge of the industry is an intangible resource with great value as producers are confronted with two problems: highly unpredictable demand patterns and production processes that are difficult to monitor and control. It is also critical for the company as it drives creativity and innovation, increasing the chances of survival in the competitive market.

Action

In this paper, the component action involves understanding user needs through experiential marketing. Innovation should not be seen as a sequential process but should include interaction and feedback, be studied as an on-going process of problem-solving (learning), and is not limited to the domain of R&D. Through experiential marketing, companies can try to understand the customer 'experience' during the consumption of goods and services. Understanding customer needs is critical for the survival of the company. 'Idea-harvesting' and user-testing have become an important and embedded element of the development process, and developers are starting to permit the insertion of user-generated content into their games. Once an online game is released to the market, the company tries to attract gamers and develop online communities with the goal of reaching critical mass for the number of subscribers. However, a

games' viability is not dependent on reaching critical mass if they can maximise resources and insert non-technological soft innovation based on new ideas and concepts. The trend towards non-technological and soft innovation increases as entrance to the market becomes more difficult. Another strategy is to move new products to new markets, for instance, video games for educational purposes.

Artifact

In this paper, the component artifact relates to how video games are both technology-based software products as well as aesthetic, interactive entertainment. Hence, it is difficult to separate content innovation from technical innovation in video game development. Innovations can range from the creation of completely new genres of content, which can lead to new markets, to redesigning familiar content within a new context such as video games based around characters or narratives developed in other media that require extensive content innovation, or the development of a more complete games world, tasks, and activities for the player. Video games are experience goods where the experience of the user is defining the quality of the game. Market positioning and branding through, for instance, changes in design or packaging helps differentiate the product and increase the possibility to gain a competitive advantage.

Audience

In this paper, the component audience addresses the challenge of video games as experience products. The video games act as creative experience products that generate emotions and experiences when played by the users. This interaction and immersiveness are essential for the success of video games. Content, design, process, or artistic innovation are perceived to be part of the 'normal' process of developing video games, and so remain hidden from traditional analysis. Changing or adding features in video games can alter the game play and experience dramatically, resulting either in players seeing the change as positive or influencing the players negatively. It becomes essential, therefore, to involve users early in the development process to increase the likelihood of product success once released to the market. This involvement can generate crucial intangible information that forms the product. As mentioned under action, experiential marketing can aid companies in understanding the customer 'experience' while playing the game. The more challenging the market becomes, the more the need for soft innovation. The combination of creative individuals with higher education institutions and external firms increases innovative ideas and knowledge produced as well as enables creativity, driving hard and soft innovation and the chance to adapt and survive in the competitive market.

Affordances

In this paper, the component affordances relate to how technology influences and is influenced in relation to its users. When it comes to the evolutionary nature of the process of game development, the use of modular technology permits new product variants to be created using the same structure. New technologies can present opportunities for process innovation in terms of distribution channels and new business models as well as product innovations from a consumer perspective. As previously stated, the video game shapes the experience of the player, hence, changes to content and features can alter the game play and experience dramatically, for better or worse. It is, therefore, only after the user plays the game that the value becomes apparent.

5.3 Paper III: Innovation in Game Development: IT Enablement and Affordances on Kickstarter (The Computer Games Journal, 2018)

Abstract: *The rise of social media platforms has changed the nature of interactions between computer game companies and players. Computer game companies have greater access to information on their needs and wants as they share information and engage with players in the development process. The purpose of this paper is to highlight how crowd-funding social media platforms, in this case, Kickstarter, can enable computer game companies and players to produce and utilise knowledge that can facilitate the game development process. In this paper, the Pöppelbuß and Malsbender conceptual framework and the IT enablement model by Jarvenpaa and Tuunainen are combined to evaluate how computer game companies can interact with players and accelerate game development using Kickstarter. The results show that Kickstarter is a useful platform for gaining access to a dedicated user base willing to share their knowledge. Kickstarter enables companies to build strong relationships with their backers via the processes of informing, responding, and promoting response. Kickstarter helps to integrate the role of the game company with that of the users by enabling both parties to engage actively with each other, rather than the game company taking a passive role of simply gathering feedback from players.*

Table 8 Key findings in paper III using the 5 A's framework

Actor	Increased knowledge using Kickstarter as a platform for interaction and communication with users.
Action	Three categories for building relations: Informing, Responding, and Promoting response. Creativity occurs in the interaction between the company, backers, and Kickstarter.
Artifact	Aesthetic design elements promote emotional responses that are communicated through visceral, behavioural, and reflective feelings communicated through a platform.
Audience	Backers are both emotionally and financially invested in the project and add pressure through suggestions and responses. The company facilitates interaction with users through identification, behavioural and visceral responses.
Affordances	The Kickstarter platform affords the company the ability to post different types of information and provides visibility, editability, persistence, metavoicing, generativity, and association, which enhance trust through good communication, thus increasing information shared by the backers.

Actor

In this paper, the component actor involves people interacting through the Kickstarter platform, in this case, management, developers, and backers. By promoting the game through Kickstarter, management and developers gain more knowledge related to the game through interacting and communicating with the backers, which, in turn, leads to increased creative production.

Action

In this paper, the component action is presented through three categories for building relations: informing, responding, and promoting response. Informing relates to informative posts and comments by the company. These can include status reports, technical reports, progress reports, testing information, and notices on launch dates. This information is simply addressed to the backers; there is no indication that the company expects a response from the backers. One could argue that providing this type of information helps the backers become more invested. It increases trust between the company and backers as the posts have a personal tone and provide transparency with behind-the-scenes information. Responding relates to comments the developers post in response to questions or comments from backers. By answering questions or clarifying comments that are negative or misinforming, the company can mitigate negativity, which could potentially discourage prospective backers and undermine the trust between the company and the backer community. Promoting response relates to posts that include visual information (such as images and videos from the game), or direct requests from the company to provide feedback (through, for instance, testing). It is in the interaction between the company, backers, and Kickstarter that creativity occurs.

Artifact

In this paper, the component artifact involves the aesthetic design elements presented on Kickstarter that promote emotional responses and can positively influence generativity; feelings of authenticity, pride, attachment, and fun. These feelings are communicated through Kickstarter, and can be categorised into visceral feelings (such as satisfaction and pleasure or dissatisfaction); behavioural feelings (predictions of and expectations about the product involving past experience and expectations of future states and events), and, reflective feelings (a strategic-level response relating to some end goal and influenced by experience, culture, and social group).

Audience

In this paper, the component audience relates to the interaction between management, developers, and backers and how there is pressure from the backers. When the company posts information to the Kickstarter platform, it is done with the intent to build a relation with the backers and provoke a response. Many backers become personally involved in the projects as they gain an ‘inside look’ into the development process and make a personal contribution towards making the project succeed both financially and through feedback and testing. The backers are no longer mere recipients of the product, but financial investors who are directly involved in the development process and its success. There might also be a sense of obligation and pressure for the developers to listen, respond, and implement the ideas and suggestions provided by backers as they are financial investors. The main categories which facilitate interaction with users are identification, behavioural and visceral responses. The facilitating condition of identification concerns (1) how backers identify with the company, (2) the company values, and (3) what is expected of the company in terms of their interaction with backers. The backers not only became financially dedicated to the project, but they used their knowledge of the project as well as other game projects to help answer questions by other backers or to provide suggestions to the company in relation to marketing, campaigning, and game development. Behavioural responses relate to the predictions of and expectations about the product by the backers; these are based on experience and expectations of future states and events. Visceral responses relate to feelings of satisfaction and pleasure or dissatisfaction. They are triggered by visualisations of images or videos.

Affordances

In this paper, the component affordances addresses how the Kickstarter platform enables the company to post different types of information; this presents the affordance of visibility (what is posted is visible to the community), editability (being able to edit the information posted), persistence (whereby this information can be archived throughout the campaign, thus enabling the backers to revisit the information from older posts), metavoicing (the ability to discuss impulses from the backers through comments), generativity (feedback and impulses triggered by posts from the company enable the company to gather inspiration and impulses for innovating and improving the game), association (compare the proposed game with their experiences with other projects of a similar nature, as well as other experiences), and editability (information can be archived until the company chooses to delete it or change the post). This, in turn, leads to more comments and questions from backers. As trust is built through good communication, the backers become increasingly keen to share their knowledge and experiences on the subject, which strengthens the community.

5.4 Paper IV: Theorising Affordance Actualisation in Digital Innovation: The Case of the Video Game Industry (SJIS, In review)

Abstract: *Digital technology provides opportunities for new product development and innovation through affordances. However, in digital innovation, human actors are constrained by the design of technology and its interaction with different aspects of the socio-technical context. In this article, we investigate the relationship between digital technology and developers in a video game development company and its role in supporting and hindering digital innovation. We build on the theory of affordances and constraints in answering the research question: How does the actualisation of affordances in video game development influence the innovation process and outcome? Based on empirical analysis, we identify four affordances: Tool development, prototyping, user testing, and patching. We theorise affordance actualisation and distinguish between innovation outcome and process innovation affordances. Furthermore, we theorise the dependencies between human actors, the organisation, and technology in the affordance actualisation process and mechanism.*

Table 9 Key findings in paper IV using the 5 A's framework

Actor	Certain stimulating conditions are found to promote creativity and innovation. The skills and knowledge of the developers and availability of technology can act as constraints on the development process.
Action	Releasing conditions initiate the actualisation process.
Artifact	Innovation outcomes were found to be process and product innovations.
Audience	Collaboration with external companies and users provides new insight, knowledge, and technology resources.
Affordances	The affordances and constraints in the relationship between technology and developers illustrate the possibilities that the technology provides its users and the role it plays in enabling and constraining activities resulting in digital innovation.

Actor

In this paper, the component actor involves management and employees and the organisational situations, specifically stimulating conditions promoting creativity and innovation. Four stimulating conditions were found: The meeting (where ideas are presented and discussed, enabling developers to voice their opinions and present their ideas), open landscape (provides transparency among the developers and their work processes), the need for distributed problem-solving (a large user base is needed to test the software properly), and establishing test procedure (which creates a safe environment for patching). Two resource constraints were also identified: The skills of the developers and the technology available determine whether ideas are feasible; hence, they function as constraints. These constraints are present during the prototyping and tool development process and affect the outcome through unforeseen technical challenges or the lack of knowledge to solve a particular problem.

Action

In this paper, the component action is represented by the concept of releasing condition. Four releasing conditions were identified: mutual agreement (the ideas that are mutually agreed upon by the developers are further tested through prototypes), patch (the availability of a software patch for installation), need for tools (a need for tools that make game development tasks easier), early access (providing the users with early access to the game to get feedback from users through testing).

Artifact

In this paper, two innovation outcomes and two process innovations were identified and represent the component artifact. The two innovation outcomes are new game functionality and new tools. The two process innovations are a process of ensuring stable software and

establishing an environment that allows for distributed problem-solving and a process through which the company can test patches and address unintended consequences (in the form of, e.g., ‘wicked problems’) in a safe environment.

Audience

In this paper, the component audience relates to feedback from players, collaboration with external companies, sharing technology and knowledge. By providing users with different versions of the game, they gain feedback from the users, new insights are generated, and innovative solutions emerge. Collaborating with other companies and sharing technology and knowledge are strategies that are pursued in certain situations to compensate for the disadvantages of being a small team.

Affordances

The component affordances relates to the four affordances identified in this paper: *prototyping* (affords the possibility of experiencing and testing creative ideas, which have innovation potential but cannot be fully evaluated until they are combined with other elements of the game), *user testing* (affords developers the opportunity to gather useful information during and after product launch), *patching* (affords developers the opportunity to securely test software updates), and *tool development* (affords developers the opportunity to acquire tools customised to their specific needs, giving them an advantage during development). All affordances influence each other to some degree. The *patching* affordance influences the *tool development* affordance as *patching* might lead to broken features, which, in turn, animate developers to create workarounds through, for example, new tools. Implementing new tools changes the way the developers work with the technology during the development and innovation process as they, for example, make certain tasks easier and faster to complete. *Prototyping* influences *user testing* as ideas, functionality, and early versions of the game are prototyped and tested both in-house and externally with players. *Prototyping* also contributes to bugs being discovered and fixed, increasing the stability and playability of the game. *Prototyping* is also sometimes used in connection with *tool development*, for example, when it comes to testing the functionality and ensuring stability. *User testing* promotes feedback from users which provides the developers with a better understanding of what works and what does not, but it also triggers new ideas which lead to new prototypes. This, in turn, strengthens the stability of the game, increases the ‘fun factor’ of the game, and nurtures positive relationships with players. The affordances and constraints in the relationship between technology and developers illustrate the

possibilities that the technology provides its users and the role it plays in enabling and constraining activities resulting in digital innovation.

5.5 Paper V: ‘Whoever is educated by anxiety is educated by possibility’ A Study of Creativity in Game Development (The Computer Games Journal, 2019)

Abstract: *The video game industry is at the forefront of technology development, which is also the case of the game industry developers. Their work requires a high level of creativity as well as technological savvy. However, working in small start-up companies also includes a great deal of worrying and even anxiety, and we know little about how these feelings influence creativity. We investigate this research question, How do top video game developers exploit worry and anxiety in their creative process?*

Our empirical approach was a qualitative exploratory study of six video game companies and start-ups. To develop our argument, we build on the concept of anxiety, as developed by Kierkegaard and May. We conclude that the particular existential situation of game developer start-ups, which are characterised by uncertainty and strong financial pressures, triggers worry and anxiety. We show in detail, somewhat surprisingly, how game developers were able to exploit even anxiety to devise creative technical solutions.

Table 10 Key findings in paper V using the 5 A's framework

Actor	Financial and game adoption pressure cause worry and anxiety and have more friction. High level of intrinsic motivation and feeling of ownership drives creative solutions.
Action	As a response to the pressure, creative solutions were implemented, presented as creative twists.
Artifact	The outcome of the creative twists. See Action
Audience	Worry is characterised by a non-critical or imminent situation, and anxiety is characterised by a critical pressure on either the product or the company in terms of its survival. The uncertainty of the outcome and the need for a solution promoted creative solutions.
Affordances	Modular technology enables flexibility and third-party development. Small changes in technology can have serious ramifications for a company as it can greatly affect the development process and progression. Hence, technology can be both the cause of worry and the solution to the problem.

Actor

In this paper, the component actor involves management and employees and how they are influenced by their sociocultural context. The game developers and managers experience various situations characterised by worry or anxiety. The most prominent situations were found to be influenced by financial or game adoption struggles. The context differs for each situation, and in the case where the developers express worry, the situation is not critical or imminent, giving the developers time to address the problem and work out a solution. Problems that lead to a sense of worry or anxiety are experienced as more challenging with a higher amount of friction than the ones that produce rational solutions. Both management and employees, experience a personal dedication and ownership of the company, and the game becomes an important part of themselves and their lives. They are driven by the intrinsic motivation that fuels creativity. Hence, the anxiety they experience provoked by financially unstable situations and their intrinsic motivation and enjoyment of game development drives creative problem-solving.

Action

In this paper, the component action can be represented by the creative twists identified. The first creative twist was using social media such as YouTube and other forums where users actively post the bugs they find on their own accord, thus increasing bug reports and enhancing the quality of the game. The second creative twist was that the developers took advantage of the flexibility in Unity by developing third-party applications to the platform. Creating the missing tools themselves depends largely on the skills and knowledge of the developers, especially the programmers. The third creative twist from one developer who decided to write dummy-guides as he had to go through all the information either way. This resulted in shorter versions of the documentations pertaining to the most important information and will, in turn, decrease the time spent reading the information in the future. The fourth creative twist was the company's decision to use the Kickstarter platform as an alternative marketing channel. They provided users with continuous updates on the process as well as some screenshots and trailers from the game. They also ran an alpha test to get direct feedback from the users. They encouraged the backers to spread information about the game through word-of-mouth marketing once the game was released. This resulted in an increased marketing reach as the backers promoted and recruited more backers, which, in turn, gave an increase in funding. The fifth creative twist to avoid situations where large parts of the game need to be redone during upgrades was to implement a routine where their lead programmer installs the upgrade, test for

issues, fix potential issues and then roll out the upgrade to the rest of the team. This way, they avoid major setbacks, gain control of the updates, and the lead programmer has a good overview of the system and process. The sixth creative twist was to remove the current campaign, rework it and relaunch in March. They improved the campaign greatly as well as employing creative solutions such as ‘Marketing Ninjas’.

Artifact

In this paper, the component artifact can be represented by the outcome of the creative twists identified. See component action for more details.

Audience

We identified two main themes causing worry or anxiety for the Norwegian game development companies; *Financial* and *game adoption*. Further, we found that game adoption problems led to situations of worry, whereas financial problems led to situations of anxiety among the developers and management. This was a common pattern overall. Worry seems to be characterised by a situation which is not critical or imminent, giving the developers time to address the problem and work out a solution. In the case of situations prone to anxiety, we found a critical pressure on either the product or the company in terms of its survival. The uncertainty of the outcome and the need for a quick solution promoted creative solutions.

Affordances

In this paper, the component of affordances relates to the interaction between developers and technology and how technology can support or hinder development. With the Internet revolution, the distribution of video games has become easier as well. This has enabled start-ups to develop and compete with the same technology and on the same platforms as large, established companies. As the development technology has become more modular, it allows for third-party applications to be added to the platform, enhancing its functionality and further enabling the developers in their activities. This is in many ways positive as developers can add functionality not provided by the platform distributor. However, many developers reported that it caused problems when there were updates from the platform as the third-party applications stopped functioning. This would lead to hours or days spent correcting the problems, further delaying the project and increasing resource spending. This can have serious ramifications for a company as it can greatly affect the development process and progression. The use of social media such as YouTube and Kickstarter simplify the interaction and communication with users

and leads, for instance, to an increase in bugs identified and understanding users' wants and needs, which, in turn, increases the stability and attractiveness of the game. Hence, the technology could be both the cause of worry and the solution to the problems.

5.6 Key findings in papers

Through within-case analysis, where I decontextualised the information of each paper using the 5 A's framework, I was able to extrapolate key findings for each component. I then compared each matrix to identify similarities and differences, synthesising the papers using the 5 A's framework presenting the recontextualised data as key findings. This is presented in Table 11 below. The recontextualised data create a reduced data set drawn from across all cases (Ayres et al., 2003, Tesch, 2013). I then use the reduced data set to move from empirical to theoretical description by further discussing the findings in the context of creativity and pressure and how they relate to digital innovation.

Table 11 Synthesising of papers and key findings

	Key Findings	Paper
Actor	The developer's characteristics and level of intrinsic motivation, supported by the open boundaries, organic process, flat structure, and digital technology, drive creativity and innovation. Greater emotional attachment and a high level of pressure lead to an increased level of emotional response.	Paper I Paper V
Action	Organic process without a goal to innovate but focus on learning from others' dos and don'ts and involving users in the development process. The innovation process includes interaction, feedback, and problem-solving (learning).	Paper I Paper II Paper III Paper IV
Artifact	Video games are experience products consisting of technical and aesthetic design elements promoting emotional responses. Digital technology enables developers to interact with external actors and develop novel technology. However, regulations and standards in platforms can hinder innovation.	Paper I Paper II Paper III
Audience	As the games are experience products, it is essential to involve users early and collaborate with external institutions and firms to increase innovative ideas and knowledge. Users can provide solutions as well as pressure on the development of a game. The uncertainty of the outcome and the need for a solution promotes creative solutions.	Paper I Paper II Paper III Paper IV Paper V
Affordance	With new technology comes new possibilities. Shortcomings in technology can foster new solutions, though small changes in technology can have serious ramifications for the development process and product.	Paper I Paper II Paper IV Paper V

6. Discussion

As presented in the introduction, the concept of pressure plays an important part in the discussion and research on creativity and digital innovation as the business environment is characterised as hypercompetitive (Müller and Ulrich, 2013), and previous research is inconsistent on the effects pressure has on creativity (Byron et al., 2010). Game development start-ups operate in a hypercompetitive market, exposing management and developers to different types and levels of pressure. Understanding how digitally fuelled creative processes unfold in game innovation under pressure can provide insight into the pressure–creativity relationship in digital innovation processes. In paper V, two main causes for pressure were found to be financial and adoption pressure. In this chapter, I discuss creative action on individual and collective levels in relation to financial and adoption pressure, presenting specific case examples and quotes to provide the reader with a deeper understanding of the phenomenon (Miles and Huberman, 1994). This is to address why and how work pressure can impact employees’ creative performance as well as the identification of potential moderators of the pressure–creativity relationship (Gutnick et al., 2012).

6.1 Individual Response to Adoption Pressure

Game adoption pressure involves challenges with meeting customer needs in a highly demanding market whilst competing with national and international companies (Rose et al., 2016). As the game is an experience product and the value cannot be known until played by the users, there is much uncertainty about the user adoption rate and whether the game meets the users’ demands. Findings show this type of pressure to be characterised by a low degree of imminence and is shown to trigger the emotional response of worry.

Findings show that the developers and managers’ dedication and feeling of ownership of the game influence the extent to which they experience pressure on an individual level. For the individual developer, the degree of intrinsic motivation plays a crucial role in whether the affordances are perceived. With a high level of intrinsic motivation, there is a good chance that the developer searches for creative solutions and sees possibilities in the technology (affordance). This is in line with Gutnick et al. (2012), stating that fostering enjoyment is positively related to creativity which increases cognitive flexibility, individuals’ explorative behaviours and the creative outcomes. If the intrinsic motivation or enjoyment is too low or non-existent, it becomes a great challenge for an individual to think creatively and see possibilities in a pressured situation. Whether the affordance is actualised depends on the

available resources such as knowledge, skills, and technology. If not available, the actualisation of that specific affordance comes to a halt while the identification of the missing resource can trigger a new process of creative action. If successful, it can feed back to the previously halted actualisation process, completing the creative action to a creative outcome. The developers expressed great passion for the game and the development process and adopted a sense of responsibility for its success. They showed the ability to attain new knowledge and skills that could contribute to new creative and innovative solutions, further increasing their intrinsic motivation. With higher motivation and commitment to the product, their emotional response of worry and uncertainty towards the product being accepted by the market and the users increased. Hence, *greater emotional attachment and a high level of pressure lead to increased level of emotional response (actor)*.

The personality and skill, as well as the intrinsic motivation of the developers, determine their response towards pressure. The developer's characteristics, such as self-driven, experimental, creative, flexible, and technologically savvy, enable creativity and innovation to emerge in seemingly effortless ways. These characteristics are the foundation for revealing possibilities in the environment and is fuelled by the need and ambition of the developers (Schreier, 2017). This becomes apparent in pressured situations as the developers are forced to address the problem through a solution. Hence, *their high intrinsic motivation, skills, and self-driven behaviour drive creative problem-solving (actor)*.

Creating something is a driver. Not economically motivated. It's the combination of all the talents of the group that makes it interesting. Progress and seeing it turn into a working game is motivating.

The example presented in paper V illustrates how a developer decided to write dummy-guides about the console platforms as he had to go through all the information either way. This resulted in shorter versions of the documentations relating to the most important information and will, in turn, decrease the time spent reading the information in the future. The documentation provides the opportunity to be shared with colleagues and other game developers. This example illustrates that an individual can trigger creativity, which then 'ripples through the resulting mesh of relations established, leading to changes and reconfigurations in both technologies and development techniques' (Panourgias et al., 2014, p. 122). The simplified documentation will decrease the learning process of other developers, both internal and external, increasing their knowledge and possibly lead to alterations or new creative actions.

As the companies are small, it is common for the developers to work beyond their designated roles to increase knowledge and skills and compensate for the lack of resources. This is supported by stimulating conditions such as *the company's organic process and flat structure with management encouraging knowledge and skills being shared within and across boundaries (actor)*.

We are not very rigid, but we have phases and deadlines we relate to, it is quite an organic process. The team feels ownership, and this is important so that everyone takes responsibility for the results.

I do not oppose change, but I think it is impossible to design a game on paper. Many things happen along the way, and it is a long process. As the project manager I try to facilitate change rather than oppose but question the choices.'

The size of the company was also reported as an important contributor towards the developers' intrinsic motivation, where intrinsic motivation decreased with a larger company.

When you have a team of 200 people, you sort of feel more detached. You care about your part of the game, but everything else sort of doesn't matter, so it becomes just like any other job really. Whereas, here, I sort of care about how the game's received and stuff. Whereas, at [the other company], I didn't really give a toss whether the game got good scores or not.

Stimulating and releasing conditions in the environment support and trigger the actualisation process. Changes in technology and its use are seen to cause positive or negative effects at all stages of the development process. The actualisation of an affordance can lead to both process and product innovation, which, in turn, provide new opportunities for action or can have devastating consequences causing pressure on the individual or firm possibly provoking new creative action or halt the actualisation process. Depending on the type of outcome (innovation outcome or process innovation), the affordance actualisation is mediated by resources in the form of developers' knowledge and abilities, organisational culture and physical workspace, and technology features and standards. Taking the creative outcome into account during the process aligns with the view of Teresa Amabile (1982), 'Any identification of a thought process as creative must finally depend on the fruit of that process—a product or response' (p.1001).

6.2 Individual Response to Financial Pressure

Financial pressure involves challenges with funding and obtaining a steady income. It is difficult for Norwegian game development companies to finance game production both in terms of income and funding. Financial pressure in relation to the individual is associated with the individual's job position and the feeling of security during turbulent times. This type of pressure is characterised by a high degree of imminence and triggers the emotional response of anxiety. It is experienced on a very personal level where the individual feels great anxiety about their position and future at the company, further influencing the individual's life beyond work. According to Rollo May (1996), 'Anxiety is the apprehension cued off by a threat to some value that the individual holds essential to his existence as a personality' (p. 189).

Findings show that the developers and management experienced episodes where the companies struggled financially and at the most extreme were on the verge of bankruptcy. One company reported that it had been a constant chase after financing where they have been on the verge of bankruptcy every six months for over four years. As the development time of one game commonly is between 1 to 4 years, this is a long time to spend insecure about the future of the company and employment. This caused tension and insecurity among the employees. When the developers' jobs were depending on the next financial aid, the anxiety level rose.

There have been many near layoffs and layoffs, and bankruptcy in one month. Almost all of 2013 was like that, except for the period June to September. Then everything was ready, and we had financing until the end of October. Once we were in September, it was, in a way, just a focus on money again. So, it's clearly an extremely inefficient way of working. If we could only have focused half a year at a time, or something, we would have done so much more.

We went unpaid until January-May. Leaned on savings and severance packs.

During the time of great insecurity and financial instability, the intrinsic motivation of the management and developers increased as they fought for their position and the company. A sense of threat can lead to higher creativity motivating employees' sense of urgency and encourage them to seek new, creative ideas actively to solve the problem at hand (Gutnick et al., 2012). This is in line with Kierkegaard's (1980) statement, 'Whoever is educated by anxiety is educated by possibility' (p. 156), though this is dependent on the level of intrinsic motivation before the problem occurs. If the intrinsic motivation is low, the feeling of anxiety and

insecurity about one's situation could become overwhelming and lead to a destructive outcome. Management can try to motivate, though research shows that extrinsic motivation is detrimental to creativity when it is imposed by others (Amabile, 2012). The same occurs if the pressure is too high and the level of anxiety becomes overwhelming (Kierkegaard, 1980). As presented in paper V, we see that the problem and the context trigger an emotion with the developers. If the problem is perceived as having an immediate, simple solution, it triggers rational problem-solving. If the problem is perceived as more challenging with a higher level of friction, it will trigger an emotional response by the developers in the form of worry or anxiety. The common situation with the start-up companies in the case was that the financial resources were scarce, leaving the developers to be creative with the resources available. One example was to take advantage of the flexibility of the game engine platform, Unity. If they lacked tools which could not be acquired, they could develop third-party applications to the platform themselves (Boudreau, 2010, Eaton et al., 2015). Hence, *shortcomings in technology foster new solutions (affordance)*.

Unity that we use has the asset store with a whole bunch of third-party off-the-shelf items that you can buy, and we have tested a lot of it ourselves, but then over time we build more of it ourselves and we try to look forward, that we plan to have more games. So that we have a toolbox to build on I think will help very much with the speed of production going forward. Unity has lots of things in it from the get-go, but this has been a collaboration between programming and design all the time. If a designer wants something and [does a task] over and over again, and it is very difficult, we can create a tool that allows [them] to get to the end result faster. So, I think we quite early on found out that we should have a database that contained much of the data for the game since it is a role-playing game that is driven by a lot of numbers lying on the backend, so [tool development] is smart for us and felt necessary.

Creating the missing tools themselves depends largely on the technology features and the skills and knowledge of the developers, especially the programmers (Bygstad et al., 2016). These function as resource constraints if not present and moderate the affordance actualisation of a creative solution (Leonardi and Barley, 2008). When a need is presented, it initiates a response from the developers either through action or reflection (Hovorka and Germonprez, 2010). The developers reflect on the possibilities for the action of the technology to address the presented need, in relation to the environment and the technological artifact.

Unity has lots of things in it from the get-go, but this has been a collaboration between programming and design all the time. If a designer wants something and does a task over and over again, and it is very cumbersome, then we can develop a tool that lets the designer get to the end result faster.

If an immediate solution is not evident, the developers often tinker (Ciborra, 1992) with the technology, altering functions and components leading to new artifacts and possibilities for design which then stimulate further reflection and ultimately tailoring (Germonprez et al., 2007) where technology is altered to suit the actors' preferences. One can argue that, with a low degree of imminence (no pressure), the developers skip the action of tinkering and go from reflection to tailoring as the developers quickly perceive a solution through rational problem-solving. Whereas if the problem is perceived as more challenging with a higher level of friction, the solution is not necessarily obvious and the need for tinkering leading to a creative solution becomes necessary (paper V).

6.3 Collective Response to Adoption Pressure

Adoption pressure on a collective level is related to a lack of development resources. When software and hardware evolve, as seen in better graphics engines and new consoles, the users expect games to meet the new specifications. The high demands of users are influenced by rapid technological development. They are also influenced by their experiences, which colour their choices in games. Predicting supply and demand whilst meeting user needs both nationally and internationally becomes difficult. In response to these challenges, the companies innovate to create value for customers, update internal development processes, and open market spaces not yet captured by the competition (Rose et al., 2016). Hence, *the uncertainty of the outcome and the need for a solution promotes creative solutions (audience).*

As findings show, start-up companies have limited economy and are not able to finance large marketing campaigns for their products or have enough employees for proper QA testing. As *video games are experience products consisting of technical and aesthetic design elements promoting emotional responses (artifact)*, user testing becomes a crucial element to gain necessary feedback on the mechanics and 'funness' of the game playing experience. The companies report challenges with completing QA testing as they cannot finance a dedicated QA team; they must rely on their developers for testing. The main problem is that they are not able to balance the process where a part of the team does testing while the rest of the team works on other parts of the game or begin development of a new game hindering further

development. This creates frustration and worry among the developers and the overall company as it can also cause a delayed release which affects their users and the budget plan. One company stated:

Since it's a small company, QA is done by lots of people, but it tends to fall to [CTO], and [Lead artist] does the visual QA, and we do sort of the game flow, game play issues. We'd address those, but it's pretty tough cause we only have five of us, and suddenly our game goes out to 1.2 million downloads and 600,000 users, and within an hour they have done 600,000 hours of playtesting and there's only five of you, so of course we have had lots of bugs. But that's my job so it helps us to design and balance the game.

Marketing is greatly influenced by the resources available as well. With little or no marketing budget or dedicated marketing staff, as is common for start-ups, it becomes a challenge to promote the game and influence potential players.

[It is] great QA testing; it really is. But it feels like we're not living up to their expectations, so being a developer is kind of hard. Then seeing maybe that you're failing the target audience – like in any game, that doesn't necessarily only apply to video games – it's kind of a weird thing. From a marketing perspective, we have a lot to take in there.

Findings show that in solving these challenges the companies took advantage of digital technology such as social media and crowdfunding platforms for both QA testing and marketing as well as funding the project, facilitating increased knowledge distribution across boundaries, further enabling new knowledge to be created and distributed in new ways (Boland Jr et al., 2007). Hence, *with new technology comes new possibilities (affordance)*. These platforms can be a great way to gain information about the wants and needs of their users. As exemplified in papers III, IV, and V, one company decided to use the Kickstarter platform as an alternative marketing channel. They provided users with continuous updates on the process as well as some screenshots and trailers from the game. They also ran an alpha and beta test to get direct feedback from the users.

Now we have had beta testing, invited every Kickstarter backer to test. And there are several who commented that they think we have done a very good job compared to what we announced on Kickstarter. After all, it is natural that you change some things and that things disappear from the plans and the like, but it seems that they are happy.

They encouraged the backers to spread information about the game through word-of-mouth marketing and employed backers as ‘Marketing Ninjas’ once the game was released. This resulted in an increased marketing reach as the backers promoted and recruited more backers which, in turn, yielded an increase in funding. Another creative example for QA testing is the use of YouTube and other forums for bug identification as users actively post the bugs they find on their own accord, increasing bug reports for the company which enhances the quality of the game once implemented. Hence, *digital technology enables developers to interact with external actors and develop novel technology. However, regulations and standards in platforms can hinder innovation (artifact)*. Still, these arenas are often treated as a one-way street where users provide information and the companies collect what is of relevance as defined by the companies themselves. For this type of information to become useful for a company, a large amount of time and resources need to be dedicated to gather and analyse the data. The companies could and should actively promote communication via these platforms despite the increased resource spending.

The developers show collaboration within the team, compensating for each other’s lack of skills and knowledge by working beyond their designated roles and learning from others. The lack of resources such as software development tools constrains the developers in their work, causing them to think creatively and develop new tools based on their skills and knowledge of the technology which, in turn, impacts and changes their current routines (Leonardi, 2011). In this example, I also found that these small changes in software could have a large negative impact on the development process as well as financial consequences, leading to greater pressure on the company. This, in turn, can foster creative action by shaping problems and providing clear challenges to be overcome (Myers and Avison, 2002). The companies also report observing market trends and the success and failure of other companies in order to gain new knowledge and information which feeds into the development process and can ultimately lead to a creative outcome. As the market moves quickly, it becomes important for the firm to have an *organic process without a goal to innovate but focus on learning from others’ dos and don’ts and involving users in the development process (action)*. As stated by Cadin and Guérin (2006), any organisation that intends to innovate and benefit from its innovations needs to act organically to stimulate innovation efficiently but also act mechanistically to be able to make use of its innovations. Involving users as part of the development process can ensure to some degree the success of the game in the market as video games are interactive artifacts, and consumer satisfaction and technical performance are not established until tested by users. Hence, *as the*

games are experience products, it is essential to involve users early and collaborate with external institutions and firms to increase innovative ideas and knowledge. Users can provide solutions as well as be a source of pressure on the development of a game (audience).

6.4 Collective Response to Financial Pressure

As previously mentioned, small start-up companies often lack the funding and income to finance technological resources, which becomes more challenging with rapid technological development. Over the past decade, the development tools and console platforms have evolved from expensive technology only a few could afford to more affordable technology for the many. With the Internet revolution, the distribution of video games has become easier as well. This has enabled start-ups to develop and compete with the same technology and on the same platforms as large, established companies. The game engines are modular, allowing third-party applications to be added to the platform, enhancing its functionality. This is, in many ways, positive as developers can customise the functionality to fit their workflow. This can, however, cause challenging situations for the company.

Findings show that even though developing third-party tools for software can aid in flexible development, lower costs, and lead to creative solutions and innovation; it can also cause challenging situations and great anxiety. As tools are added to a third-party software, there is a great risk of them breaking when new updates are released and implemented. Many developers reported that, when there were updates from the platform, some third-party applications stopped functioning. This would lead to hours or days spent correcting the problems, further delaying the project and increasing the resource spending in the firm. This can greatly affect the development process and progression. Hence, *small changes in technology can have serious ramifications for the development process and product (affordance).*

So, there were dark days for a while, like five months where all the lighting... [the CEO] was here at crazy hours trying to get lighting set. It was horrible. That's the downside of a third-party system.

The anxiety lies in the loss of time and resources while everything is being fixed. Small start-up companies often have little slack in time and resources, which leads to the situation quickly escalating to a crisis.

Unity has clearly been the biggest problem when it comes to things that have to be re-done. Also, we have tried not to upgrade, but then we are forced to upgrade. So, it has just opened a pandora's box of things that have to be re-done. It's not just that I have to go back to bake the light again in every scene, everything looks different, so you have to go about all the lighting in a different way. It takes a long time per scene, and we have over one hundred scenes.

One company adjusted to the pressure of technological change by changing the routines for upgrades where their lead programmer installs the upgrade, test for issues, fixes potential issues and then rolls out the upgrade to the rest of the team. This way, they avoid major setbacks, gain control of the updates, and the lead programmer has a good overview of the system and process. This shows the entire company collaborating through *interaction, feedback, and problem-solving (action)*. Mayer (2006) states that a set of constraints can foster creativity by shaping problems and providing clear challenges to be overcome. Creative and technological resources can represent an opportunity and a tool to gain control over challenging situations (Zackariasson et al., 2006), and pressure situations can function as 'catalysts for action', motivating individuals to address issues and problems in their environment (Gutnick et al., 2012).

External audience acts as both the cause of pressure and support for development by supplying or withholding resources. As presented in the findings, it is common for start-up companies to struggle financially. This is shown to cause great pressure and anxiety for the company and its employees. Receiving financial aid from financial institutions is fundamental, though often the company will have to obtain funding by other means as well. Digital technology such as the crowdfunding platform Kickstarter affords the companies the opportunity to finance their projects as well as market the game and gather feedback from the backers. Such digital platforms are key to the growth of small start-up companies as they afford the ability to engage the users directly and to gather useful information which can foster creative solutions, as shown in paper III. The users push development and innovation by communicating their wants and needs, delivering high demands influenced by technological development, and function as a resource through user testing, financial backing, and idea generation that can result in positive generativity and a creative outcome. Financing company resources can be a great challenge and hiring new employees is limited, forcing the employees to go beyond their designated work roles. Findings show that there is a strong collaborative culture among Norwegian game development companies. They share knowledge and technology to help each other and, on

occasion, hire external employees or even entire companies for shorter periods to increase their resources. This leads to new and creative solutions for both companies involved.

The team has evolved, and everything is going faster now with more knowledge. We have also brought in new experienced people who make [the game] better and of higher quality. We then start to look at what we have done earlier and want to improve this, but then it is quick to get into an 'infinite loop' and make 'Duke Nukem' forever, so we have taken some things and redesigned, for example., home bases. At the same time, it has improved design and increased flexibility.

There is a lot of networking on social media platforms where we discuss everything from business models, technology choices, good and bad partners. Then we learn from one another.'

This shows how 'diverse actors' individual innovations, as well as how those actors and their activities are interrelated and produce waves of innovation spreading beyond the boundaries of their communities' (Boland Jr et al., 2007, p.634).

6.5 The interplay of the 5 A's of creativity

In this thesis so far, I have decontextualised the findings from paper I-V using the 5 A's of creativity framework and recontextualised and discussed the key findings in relation to pressure on individual and collective levels. In this chapter, which builds largely on the contribution from paper IV, I will discuss the findings in relation to one another to show the interplay and dependencies of each component in the creative process of digital innovation necessary to achieve a holistic perspective of the process (Seidel et al., 2010, Strong et al., 2014, Nambisan, 2017). The discussion of creative action under pressure shows how, on both individual and collective levels, digital technology is utilised as a solution to challenging problems, as a source for creativity and innovation. The companies are influenced by the 'organisational context through stimulating and releasing conditions (cf. decisions) that trigger processes of affordance actualisation. Depending on the type of outcome (process or product), the affordance actualisation is affected by resource constraints in the form of developer skills or availability of technology' (paper IV, p.18). This is illustrated by the examples of user testing through Kickstarter and YouTube, funding through Kickstarter, the development of third-party software and marketing on Kickstarter. As presented in paper IV, 'the action potential of technology (affordances) is both about enabling innovative solutions (outcome) and the activities through

which such solutions are generated (process)’. Thus, when companies find themselves in a pressured situation, they respond by utilising affordances in the digital landscape to find creative solutions. It is a developing process and a goal executed through trial and error, observation and adjustments, shaping the goal through the means available to the actor, making discoveries through the dynamic process of creation (Joas and Kilpinen, 2007). We see that these actions are executed through reflection, tinkering, and tailoring. The technological resources can represent an opportunity and a tool to gain control over challenging situations (Zackariasson et al., 2006) but function as restraints as well, which, in turn, may stimulate new creative actions and innovation opportunities. Hence, pressure promotes creative action through technological affordances.

In paper IV, we presented the mechanism for affordance actualisation through research on the interaction of the actors and digital technology and how creative solutions emerge in a high-pressure environment. We identified a trifecta (Figure 6) between the actor, organisation, and technology components which are interdependent in the affordance actualisation process. This is in accordance with Glăveanu (2013), which states that ‘creative action emerges out of actor–audience relations that both produce and are mediated by the generation and use of new artifacts (objects, signs, symbols, etc.) within a physical, social, and cultural environment. In the end, this environment and its affordances are also gradually transformed by creative action’.

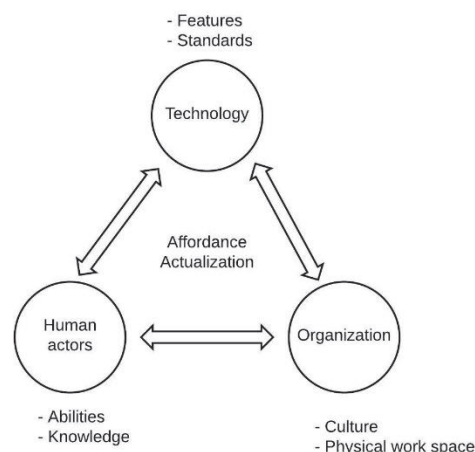


Figure 6 Affordance actualisation trifecta (Paper IV)

The trifecta model shows an interdependence of technology, actors, and organisation and their influencing properties in actualising affordances. The actors involved possess knowledge and

abilities which form the basis for their opinions and actions. They act upon the releasing conditions of affordance actualisation. The organisation provides an environment for affordance actualisation through organisational culture and the physical workspace. It is, therefore, directly related to the stimulating conditions. Features and standards of technology mediate the human actors and organisational components. Moving from a relational perspective of affordances to a process perspective of the actualisation of affordances, we see that affordance actualisation depends on the stimulating and releasing conditions related to the human actors and organisation components of the tripecta (Figure 6), which is part of the social subsystem, and the technology component that is part of the technical subsystem. This builds on the socio-technical perspective of relational subsystems by Bostrom & Heinen (1977). Affordance actualisation implies human action, which is related to the three components of the tripecta (Figure 6) and dependent on the social and technical subsystems, which are presented in the affordance actualisation model below (Figure 7).

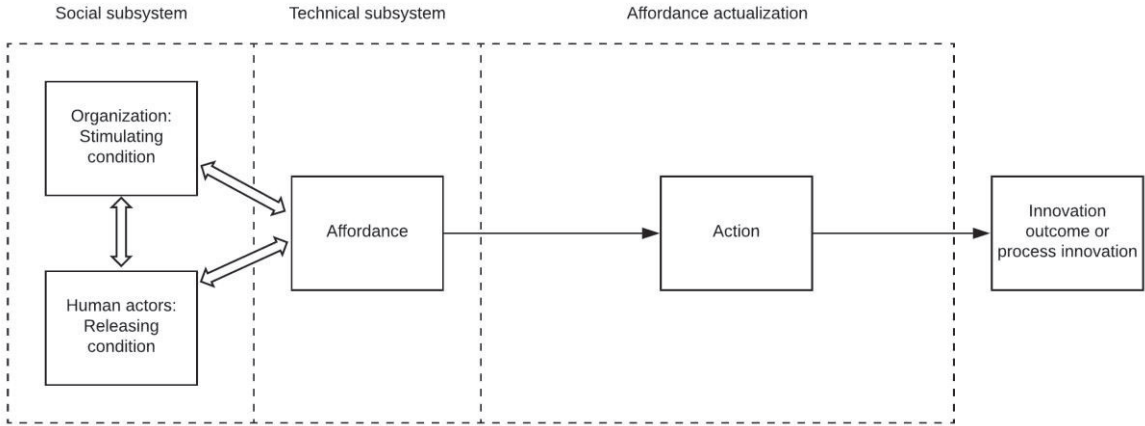


Figure 7 Affordance actualisation (Paper IV)

What the model in Figure 7 does not present is the influencing pressure of the component audience. In Chapter 7, I propose a model for the digital innovation process and seek to provide new insight on creative processes in digital innovation, addressing the role of digital technology and human actors during this process in high-pressure environments.

7. Contributions

7.1 The digitally fuelled creative process in game innovation under pressure

It has long been stated by researchers that there is a need for more research on creativity and the creative process in the field of IS and digital innovation (Seidel et al., 2010, Müller and Ulrich, 2013, Couger et al., 1993) and the role of digital technology and human actors during development in organisational contexts, how these components can shape creative and innovative solutions in a high-pressure environment to achieve a holistic understanding of the digital innovation process (Strong et al., 2014, Orlikowski and Scott, 2008, Nambisan, 2017). As the market is characterised as hypercompetitive, there is an increasing need for more research, especially empirical studies, on why and how pressure can impact employees' creative performance as well as the identification of potential moderators of the pressure–creativity relationship and our knowledge of the boundary conditions of this linkage (Gutnick et al., 2012). Hence, this thesis has aimed to extend the current understanding of creative processes in digital innovation, addressing the role of digital technology and human actors during this process in high-pressure environments by answering the proposed research question, *How do digitally fuelled creative processes unfold in game innovation under pressure?* Through the analysis of the case study of select Norwegian computer game start-ups, the findings suggest that the developers, on an individual and collective level, utilise technology as a creative solution to the pressures they face. The creative process is moderated by audience, organisation, and technology as well as the actor's skill, knowledge, and motivation. To illustrate this further and contribute theoretically to the field of IS, digital innovation, and creativity, I propose a new model (Figure 8) for the digital innovation process and the actualisation from creative idea to creative or innovative solution. With this, I seek to provide new insight into creative processes in digital innovation, addressing the role of digital technology and human actors during this process in high-pressure environments. The model shows the interaction between the 5 A components actors, action, affordances, audience and artifact in the development process from idea to final product in a high-pressure environment. First, I present the model and, following an explanation and discussion of its relevance to the IS and digital innovation field, address the research gap and research question presented.

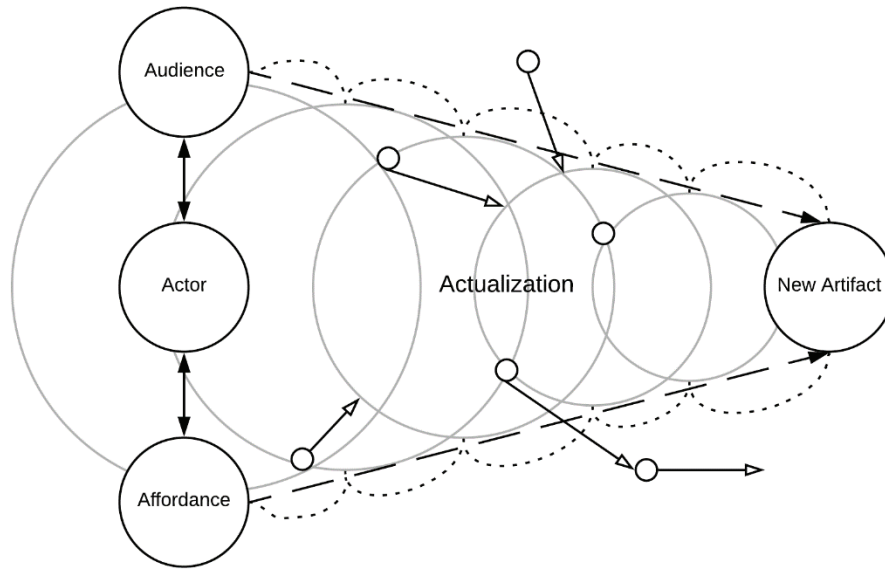


Figure 8 Model of the digital innovation process under pressure

The model takes into account the components of the 5 A's in the framework by Glăveanu (2013), combining *actor*, *audience*, *affordance*, *action (actualisation)*, and *artifact*, but is laid sideways to illustrate the process from initial idea to new artifact. The model shows how creative action emerges through the interaction between the developers and management (actor), external companies and the user base (audience), and digital technology (affordance), and is then actualised in the production of a new artifact. Knowledge, skills, and motivation by the individual actor moderate the ability to perceive and actualise an idea, while technology (affordances) and audience moderates by driving the process forward, hindering it or being a cause of pressure in this process. We see from the findings that pressure (illustrated by the small dotted lines), which can stem from technology or the environment, influence both individuals and the collective firm (management and developers), which triggers an emotional response and action to produce a creative solution. Further, development is influenced by the organisational context through stimulating conditions and human actors' decisions to act (cf., releasing conditions), which trigger processes of affordance actualisation. When an affordance is realised through a creative action between an actor and technology, it initiates a motion throughout the firm, which can trigger new creative solutions. To illustrate this, I was inspired by the theory of wakes of innovation by Boland Jr et al. (2007), which in this model present wakes of creativity through the illustration of circles rippling through the firm. As the boundaries between the firm and its environment have become more permeable, where knowledge and ideas flow inward and outward in the interaction with external firms, academic

institutions, and consumers (Chesbrough, 2006), it will influence the creative activity, colliding with current creative actions in motion and possibly causing new wakes of creativity illustrated by the ‘autonomous, vibrating nodes that create complex sets of connections from relatively simple interactions taking place in their trading zones’ (Boland Jr et al., 2007, p. 643). For each action, there is a reaction; in the collisions between different wakes of creativity, a reaction is set forth, causing the actors to reflect on the changes and respond through tinkering and/or tailoring. Ultimately, this results in new artifacts, whether it be changes in processes or products.

This theoretical model is a response to the need for the development of a process theory that explains IT-enabled creative processes and the theorisation about the socio-technical context in which creativity unfolds by investigating the complex interplay of creative persons, products, processes, and (IT-enabled) contexts at the individual and collective level (Seidel et al., 2010). By combining different perspectives from information systems, digital innovation, psychology, and creativity theory, I was able to address the great complexity of creativity which is innately human and the process which it unfolds that consists of multiple interrelated components on the levels of the individual, collective, and organisational.

7.2 Propositions for management

Through the analysis, I have identified certain factors that support creativity and innovation and how audience and affordances play an important role in driving, hindering, or causing pressure on the innovation process. The theoretical model provides practitioners with an overview of components and their relation to each other and the creative process and how these can, in interrelation, result in innovative solutions. On a practical level, I present propositions aimed at individual employees and management on how to promote and stimulate creative actions in the firm.

Proposition 1: Individuals should go outside of their designated roles to acquire new knowledge and skills, which can increase intrinsic motivation and the chance to discover creative solutions.

Individuals have the power to be selective and constructive in interacting with cultural material, which gives rise to new knowledge and creative action (Valsiner and Connolly, 1997). By actively seeking ways to gain new skills and tinker with technology and other available resources, one can increase the level of expertise and become more invested in the related

project. This, in turn, could increase one's intrinsic motivation and can aid in the discovery of new affordances leading to creative solutions. This leads to the following proposition.

Proposition 2: Individual actors should explore new possibilities through tinkering and tailoring during pressured situations.

Proposition 3: Management should create an environment which fosters intrinsic motivation by supporting the employees' interests and endeavours both outside and inside company boundaries.

Management should avoid incentives that do not provide any personal value for the employees if the goal is to increase creative activity and solutions. By understanding the needs of the employees individually and as a team, management can encourage them by allowing them to pursue personal projects outside of the company, leading to increased knowledge and skills further benefitting the company.

Proposition 4: Management should implement creative projects in controlled environments to stimulate creativity in teams.

Management can also implement projects with 'controlled friction', as presented in paper V, where one simulates a chaotic environment with pressure elements such as short deadlines and limited resources to increase the creative output in a company whose team members experience a standstill in their production of novel products. These can mimic game jams where the aim is to train the social, innovation, technical, and design skills of the development team members as well as facilitating collaborative development processes (Wirman and Jones, 2019). What is important to note is that one must make sure the team is intrinsically motivated to participate in such an activity. If the decision is imposed on the team by management and not communicated to the team as a collective effort, the potential for creative output could be hindered. Also, the duration of the project should be short (1-2 weeks) for the team to be continuously productive. As commented by a project manager:

We have learned to create games in very short time, a new experience for all of us... We now know that we have the capacity, expertise, and focus to make other games in a short period. It's a good experience to see what others can contribute and how quickly and accurately they work.

8. Conclusion and future research

I set out to explore *how digitally fuelled creative processes unfold in game innovation under pressure* to address the need for more research on creativity and the creative process in the field of IS and digital innovation (Seidel et al., 2010, Müller and Ulrich, 2013, Couger et al., 1993) and the role of digital technology and human actors during development in organisational contexts, how these components can shape creative and innovative solutions in a high-pressure environment to achieve a holistic understanding of the digital innovation process (Strong et al., 2014, Orlikowski and Scott, 2008, Nambisan, 2017).

By drawing on different theoretical perspectives from information systems, digital innovation, psychology, and creativity theory, I developed a holistic process model of digital innovation which aids in the explanation of how social actors and digital technologies interact and shape creative solutions in a high-pressure environment. The digital innovation model (Figure 8) illustrates how each component is interdependent and how pressure and environmental conditions influence creative activity in the development of an IT artifact. Further, I theorise on the actualisation of creative action under pressure on individual and collective levels, where intrinsic motivation—in combination with skills and knowledge—is key in enabling individuals to perceive possibilities (affordances) in the technology and environment, fostering creativity, whilst collectively technology is creatively utilised to go beyond the company boundaries to gain knowledge and resources from external actors, further fostering creative action.

The Trifecta (figure 6) and figure 7, aims to deliver a novel presentation of how to understand affordances in a socio-technical perspective. This contributes, not only in terms of applying affordance analysis to a videogame developer, but more importantly the significance of the “Trifecta” - as a sociotechnical system presentation - to understand the releasing and constraining conditions in a system that covers actors, technology and organization. This is a novel contribution to existing game study research and furthers our understanding of the innovation process in this context (Kerr, 2017).

On a practical level, I present four propositions for stimulating creative action for the individual and management. These are meant to guide practitioners of both game development as well as other industries in their innovation endeavours specifically in start-up companies in a high-pressure environment. The contributions of this thesis can aid practitioners to respond creatively to these challenges and use their personal, organisational, and technological resources to their advantage in the pursuit of digital innovation.

The research was conducted in the Norwegian video game industry with a focus on start-up companies. This limits the contribution on an organisational as well as geographical level. As a small start-up game company is quite different from a larger company or AAA game company the pressure and response could differ depending on the context/case. Several factors such as financing, culture and market are country specific and would presumably affect the type of pressure experienced by the companies. An area for further research could be to identify mechanisms specific to how the creative actions identified unfold under different degrees of pressure. Studying the theory and model of digital innovation under pressure presented in this thesis in a different context, whether another country, larger AAA game companies or other industries, would be of interest for future research as well. This could reveal other types and levels of pressure and actions to those pressures, provide greater insight into the differences between countries and organisations and reveal other challenges for consideration.

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PATTERNS OF INTERACTION INFLUENCING INNOVATION IN THE VIDEO GAME INDUSTRY

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ABSTRACT

The video game industry (VGI) is a highly creative and fast-paced industry where innovation is a necessity to stay ahead. The innovation processes in the VGI are not rigorously explored and often treated like a “black-box”. Much attention has been towards game design and function, on the product innovation, not on the process. In this paper, patterns of interaction supporting innovation in the VGI are investigated through an engaged scholarship approach through interviews and observations with video game companies and informants in Norway. The findings show there are four identifiable patterns of interaction influencing the innovation process by reinforcing or hindering it. By understanding how the complex VGI environment and its actors interact, the company can increase its innovation capability and thereby its competitive advantage.

Key words: Innovation process, patterns of interaction, video game industry

1. INTRODUCTION

For a company to be competitive in the market today it needs to improve their process and develop new products and services. With increased focus on national and international competition, innovation in companies has received more attention. It is no longer a question *if* companies should innovate, but *how* they should innovate (Figuerola and Conceição 2000; Iden et al. 2013). It is however difficult to recognise how innovation is supported in a company. Although extensive research has been done on the subject of innovation in organisational context and in areas of product development, business models, process and service innovation, less is known about how innovation is reinforced through interaction between internal and external actors (Håkansson 2013; Selander et al. 2010). As innovation rarely comes from one individual, but is often the result of collaboration between teams and companies it seems essential to understand how these interactions influence innovation.

In this paper, Norwegian game development companies and the industry are explored with the intention to understand how patterns of interaction among actors can support or hinder innovation. The literature to date is not comprehensive on the complex dynamics of innovation in game development and industry settings as well as the interaction between actors to support the innovation (Considine and Lewis 2007; Edwards 2000; Edwards et al. 2005; Hotho and Champion 2011; Selander et al. 2010). This leads to the research question addressed in this paper: *What patterns of interaction characterise the innovation process in the Norwegian video game industry?* The exploratory nature of this paper will provide an early attempt at understanding the VGI, how the actors interact and its influence on the company’s innovation process. This is done through an engaged scholarship approach (Van de Ven 2007) with companies and key informants in the Norwegian VGI.

2. PRIOR RESEARCH

In today’s rapidly changing markets, companies are forced to respond to the needs and requirements of users. Effective innovation management is thus imperative for the industry. This can only be improved on the basis of a better understanding of barriers to and impediments of this process (Hotho and Champion 2011). By leveraging cooperation with external companies by harnessing the power in the environment, companies can co-evolve their capabilities and roles to create additional value (Williamson and Meyer 2012). The knowledge of interaction processes, their patterns and how these create innovations,

productivity and distribute profit is limited and in some aspects missing (Håkansson 2013). Much of the innovation process in organisations has been treated like a “black-box” according to Fagerberg (2006), leaving what happens inside this box to scholars of different fields to explore. Miles and Green (2008) present the concept of hidden innovation in creative organisations. In their reports for NESTA (2006, 2007, 2008) “hidden innovation” is innovation not captured or recognised by traditional indicators such as research and development (R&D) spending or number of patents. The influence of innovation on organisations and its processes have largely been ignored (Alha 2011; Edwards 2000; Lee 2010). It is therefore important to identify, describe and analyse interactions and patterns of interaction influencing innovation and their consequence for companies, the industry and the society at large (Håkansson 2013).

2.1 The Video Game Industry

The VGI is a highly creative and fast-paced industry, requiring competent and complex teams of programmers, designers, artists, musicians, producers, testers, and project managers (Bygstad and Waal 2013). An increase in demand of video games from all ages has led to industry growth. The video game industries’ economic significance is recognised worldwide (Hotho and Champion 2011). It has changed the way we play, learn, teach and work. Video games are no longer just for kids, but played by people of all ages. The average age of game players in 2013 was 30 (ESA 2013). With the increasing portability of games available on consoles and handheld devices such as mobile phones and tablets, new markets emerge and reaches a diverse user base. Changes in markets and the competitive strategies of large companies have increased the pressure on smaller companies to focus on innovation, innovation capabilities and innovation management (Hotho and Champion 2011). Innovation plays a big part in the long-term success of the video game industry, as game publishers and hardware engineers design products that meet the needs of segments of the population (Wesley and Barczak 2010). However, the innovation process in the VGI is not rigorously explored. Much attention has been towards game design and function, on the product innovation, not on the process (Kultima et al. 2011). Innovation in the VGI, as in many other industries, occur in different areas such as technology, business models, processes, product and management. The challenge being the great difference between companies in how they approach innovation, and if innovation is even a part of the company’s goal or strategy. There are many actors entwined creating dynamic relationships affecting a multitude of areas. Technology is constantly shifting, organizational strategies are changing, and policies are altering the game. Companies in turbulent industries such as the VGI are likely to undergo frequent changes triggered by external opportunity and internal strategic response (Hotho and Champion 2011).

Identifying which factors lead to successful innovation in an industry is challenging and something many researchers have strived to do. There is no one common measure of success, and success is a composite of a number of subjective and objective measures (Balachandra and Friar 1997). According to Balachandra and Friar (1997), four broad categories from marketing strategy can aid in structuring information to provide a better understanding of a phenomenon. These categories are *market*, *technology*, *environment*, and *organisation*. These categories are used systematically throughout this paper with a closer look at the Norwegian VGI.

2.2 The Norwegian Video Game Industry

The video game industry in Norway is small and young with an increasing number of start-up companies that fight to break through and become successful. There is estimated about 100 active game development companies in Norway with a varying degree of production and revenue. This is an increase of 35, 61% since 2012 (Jørgensen 2014). This increase is a result of industry veterans as well as newly educated developers establishing indie companies (small independent companies without significant financial support of a video game publisher or other outside source) with their own productions. With such a rapid growth it becomes evident that competition for market establishment increases and so does the need for new and innovative ideas which are crucial to a company’s survival (Fagerberg et al. 2006). There are many challenges in the Norwegian VGI, not just for the individual companies, but also for the industry as a whole.

2.2.1 Market

The main feature is whether the new product is entering an established market or is an innovative product for which there is no established market (Balachandra and Friar 1997). When it comes to the Norwegian VGI, the market is currently not large enough to satisfy a growing industry. Establishing a strong market with international competition and generating capital through this market is challenging. Marketing and sales are done differently in the VGI as computer games are commercial software, not sold to companies,

but to individual gamers in a global market, at retail prices. Success is mainly measured in number of copies sold, preferably in millions (Bygstad and Waal 2013). Meeting customer needs both nationally and internationally is challenging. Supply and demand in this industry is very difficult to predict (Jørgensen 2009) and when it comes to analysing the market it usually leads to small, incremental innovations rather than major innovations (Balachandra and Friar 1997).

2.2.2 *Technology*

In the VGI, technology provides tools for both development and distribution of games. Game consoles experience an accelerated rate of technological change, such as processing power, peripherals and user interface. The development practices and processes have been influenced greatly by the digital revolution (Bakhshi and Mateos-Garcia 2010). New forms of distribution through the internet becomes a necessity for Norwegian game developers so they can reach out to national and international markets where they can earn enough money to be self-reliant (Jørgensen 2013). In a small market like Norway, creating their own distribution and publishing platform is vital as many games are published in Norwegian and thus do not reach the international market. This results in more control over distribution and ownership of the company and their product (Jørgensen 2009). New funding platforms such as crowdfunding through Kickstarter (Kickstarter 2014) and early access on Steam (Steam 2014) provide sources for additional income as well as verification from users and the market throughout the development process.

Successful product development depends on the degree of innovativeness (Balachandra and Friar 1997). The more innovative the product the higher the risk of failure. Many incrementally innovate to avoid this and to meet the customer demand. An important part of the computer game industry is also linked to the development and sale of electronic components such as video game consoles and graphics cards, with a very close connection between the development of hardware and software in all areas of the industry. The connection between hardware and software also emphasizes that the games industry is not a unified industry, but consists of different industries with different technological and economic solutions (Jørgensen 2009). The software (game) determines what consumers are going to play; the hardware (console, PC etc.) determines how they play it.

2.2.3 *Environment*

The environment consists of a number of different aspects, such as political and social factors, public interest in the product, and social acceptability of the product (Balachandra and Friar 1997). In a white report from the Parliament (2007-2008), an initiative to strengthen the VGI in Norway is expressed, but with a focus on Norwegian culture and language aimed towards children and young adults. One of the main public funding organisations, the Norwegian Film Institute (NFI), operating under the Ministry for Culture, provides as much as 75% funding for game development as long as the product meets three of the four criteria for a cultural product (NFI 2014). Small start-up companies benefit greatly from the financial support from NFI as it provides enough capital to get started (Jørgensen 2013).

Another financial actor is Innovation Norway, which is currently the agency gaming companies often turn to for additional and more market-oriented support. Innovation Norway has various schemes that contribute to innovation and the development of competitive enterprises in the Norwegian sector (Jørgensen 2013). These two organisations together provide game development companies with enough capital to begin production, though not enough to become self-reliant. This requires a sustainable income and investments and is what many game developers struggle with. Interacting with users is a large part of the video game industry not only as knowledge providers, but also as financial supporters through social media platforms such as crowdfunding, wiki/forums, blogs and playtests, the companies interact with users, receive funding and valuable information pertaining to interest of the product. Kickstarter is an example of such a platform, a funding platform for creative projects (Kickstarter 2014). Every project is independently crafted while friends, fans and total strangers offer to fund them in return for rewards (Moreau 2014). Another form of interaction happens through usability testing, which is a critical part of the R&D process as video games are interactive artefacts, and consumer satisfaction and technical performance are not established until tested by users (Bakhshi and Mateos-Garcia 2010). Though many authors have analysed the difficulty of getting good information on customer needs for innovative products in potential markets because customer preferences may not be known by the customers themselves (Balachandra and Friar 1997).

2.2.4 Organisation

The Norwegian game industry is mostly comprised of small companies with an average of 5-10 employees (Jørgensen 2014). The teams often work in open workspaces providing ease of communication among the different team-members and visual stimulation through artwork and models (Nandhakumar et al. 2013). There is often a twin leadership between the director (responsible for the game product) and the producer (responsible for the project), who will have to work out the compromises between economic and artistic priorities (Bygstad and Waal 2013). Cadin and Guérin (2006) state that any organisation that intends to innovate and benefit from its innovations need to act organically to stimulate innovation in an efficient manner, but also act mechanistically to be able to make use of its innovations. This creates conflicting interests between management and developers where the creative dimension and routines for commercial utility collide (Hotho and Champion 2011). The companies work iterative to experiment with new ideas and produce or modify technologies necessary to deliver them (Bakhshi and Mateos-Garcia 2010).

2.3 Summing Up

From the prior research, it is shown that there are four important categories, *market*, *technology*, *environment* and *organisation*, which aid in structuring information to understand a phenomenon. These categories have been used here to structure information pertaining to the Norwegian video game industry showing specific challenges to the industry. What is unclear in previous research is how such a creative and volatile industry deals with the interaction processes, their patterns and how these create innovations, productivity and distribute profit. Further, this paper will present the applied methodology in chapter 3, and thereafter chapter 4 presents my findings. Chapter 5 presents the discussion and chapter 6 the conclusion and thoughts for further research.

3. METHOD

For the purpose of this project, an exploratory qualitative study was done in order to obtain as much data as possible within a complex subject over a short period. The research question *What patterns of interaction characterise the innovation process in the Norwegian video game industry?* requires an approach where the data reveals a problem in need of further research. The engaged scholarship approach was chosen for this purpose. It is a participative form of research for obtaining the different perspectives of key stakeholders (researchers, users, clients, sponsors, and practitioners) in studying complex problems (Van de Ven 2007).

3.1 Data Collection

Data was collected through semi-structured interviews with several informants in the Norwegian video game industry and observations were done at two of the four companies where notes were taken and questions were asked during the observation. Semi-structured interviews were completed with management on two or more occasions with each company. As seen in Table 1, the first step in the data collection process was to identify which video game companies were currently most active in Norway. Active in this context was defined through information from the Brønnøysund Register, a Norwegian government digital register, the Norwegian Film Institute (NFI), and Joingame, a national resource network funded by the Norwegian Research Council, which gave an indication of funding amount, times funded, years active, profitability and membership status in Joingame. By crossing this data, a list of most active companies as of 2013 was generated. An email was then sent to the top ten companies as well as approaching the ones attending the Norwegian game expo, Spilleexpo. Interviews and observations were then done with the companies and informants interested in the study. This was done in intervals during fall 2013 and spring 2014.

<i>Step</i>	<i>Description</i>	<i>Output</i>
1	Generate list of most active video game companies in Norway	List of most active companies
2	Send general mail to potential video game companies	
3	Attend Spilleexpo to talk to Norwegian indie game companies	Summary
4	Interview key people in the companies contacted and other relevant informants	Transcripts
5	Observe companies during work on game projects	Field notes

Table 1 Steps to data collection

3.2 Case Selection

The four companies selected for this study were from the list of top ten most active companies in Norway at the time as described in the above section. They are of different sizes and with vastly different projects. This provided the study with a broad base of information that could give a broader visual of the industry rather than having very similar companies in the selection.

Company A is a small independent game development studio founded in 2002 with more than 15 employees working on a range of video games for several platforms such as mobile, PC, XBOX, Playstation and Nintendo. The studio has released more than 10 games and are currently working on two new games. They have received funding from NFI about seven times and in the total amount of about 7 000 000 NOK.

Company B is a small independent game studio consisting of a team of around 10 people varying from project to project. The company was founded in 2009 and has released one game for the iPad so far with two games in the making. They have received funding through NFI 7 times in total about 4 000 000 NOK.

Company C is a small independent game studio with seven employees and was founded in 2010. They have released two games on PC, Android and iOS and are currently working on one new game. They have received funding from NFI two times in the total amount of about 400 000 NOK.

Company D is a small independent game studio founded in 2012. There are about 12 people that make up the core of the company and several hired for work on specific projects. They have yet to release a game, but have two in the making. They have received funding through NFI four times in the total amount of about 4 500 000 NOK.

3.3 Data Analysis

Field notes and transcribed interviews were analysed using data displays (Miles and Huberman 1994) and findings were discussed with informants to gain practical understanding of a complex topic in accordance to the engaged scholarship method (Van de Ven 2007). The five steps shown in the table below were followed to analyse the data material and answer the research question. The interviews were transcribed and the field notes summarised. The text was then placed in tables and coded to identify similarities and differences among the responses. These codes were then conceptualised and arranged into the four broad categories revealing the patterns of interaction.

<i>Step</i>	<i>Description</i>	<i>Output</i>
1	Summarise data from interviews and observations	Initial matrix
2	Code interviews and observations	Table with key points
3	Draw concepts from code	Groups of data
4	Create broad categories from groups of data	Early theory
5	Elaborate theory with explanations in subject area	Patterns of interaction

Table 2 Steps to data analysis

4. FINDINGS

This section presents the findings from the interviews and observations done. The four categories of *market*, *technology*, *environment* and *organisation* are used to categorise the findings.

4.1 Market

The greatest challenge in the Norwegian video game industry is generating capital and establishing a strong market with international competition. Observing market trends and the success and failure of other companies can provide the game development companies necessary information to make decisions on unknown factors. As the market moves quickly it becomes important to pay attention to what works, how it works and understand why it works. In this study, the companies observed other companies, which give indicators to what the market wants and how to successfully market the products to potential users through for instance a crowdfunding campaign. As one of the project managers stated:

“We learn from others' mistakes.”

One of the CEOs stated:

“There is also a lot of networking on social media platforms where we discuss everything from business models, technology choices, good and bad partners. Then we learn from one another.”

The Norwegian VGI is small, consisting of small indie companies with little impact on the international market. To become a viable industry, the companies need to provide games that create international interest.

One programmer stated:

“I follow a lot of what's going to happen and when the new consoles come out, and what I hope is that we here in Norway may be included in the new console generation. Right now we are not a part of it and we are currently very far behind absolutely everyone in the industry so we'll see if we can come up with a whole new generation. Try to be more relevant in the market.”

4.2 Technology

Technology in the video game industry is vast and ranges from tools to develop games to the technology displaying the game. In this case, technology is split into two broad categories; development platforms and console platforms. A development platform as mentioned here is a middleware used to develop a game. The findings show that many companies develop their own technology in combination with mainly Unity as a platform. As tools for developing video games have become less expensive and more user friendly, many companies invest in middleware which is suitable for their purpose and create modules to customise its use. This provided that the standardised platform is flexible at its core allowing external modules to interact. As one project manager stated:

“When it comes to technology we buy all of the tools through Unity. But then we find something that is not made before, then we must make it.”

The CEO of one company presented their own development platform, which had been their main tool for a decade, but stated that an integration with a middleware was planned in the near future.

“We created a framework that is modular. We have added more as new technologies have come with new platforms and features. The platform is extremely stable, compatible and with little bugs. It worked perfectly, but we see that we cannot get things instantly up and running such as Unity with immediate results. Our next innovative step in technology development is to create a parallel project with Unity and see how we can make it compatible with our existing tech. If we get it to work then the doors are open and we can achieve anything!”

A console platform is a device that outputs a signal to display a game, such as PlayStation, Xbox and Nintendo, but also PC and mobile platforms. The console platforms set the standard for what video games can do. Findings show that when new consoles or technologies are introduced to the market it provides innovation possibilities for the game developers.

“Innovation to me means that you get access to new technology that can be used, such as Oculus Rift that has managed to innovate and create something new. New consoles enables developers to do new things.” – Programmer

The vast amount of consoles from PC, Playstation, XBOX, and mobile, reaches a larger user base from casual to seasoned gamers and provides an increased room for innovation.

4.3 Environment

The environment in the video game industry consists of several external and internal actors that interact and affect each other. This section is therefore split into three sub-categories: users, game development companies, and government and financial institutions.

4.3.1 Users

The term users is a wide term covering different groups of people. In this case, a user is a consumer and gamer. The findings show that involving users in the development process is challenging. The companies find it difficult to distinguish between quality information important to the product and “white noise” which has little or no value for the product in the end. Platforms such as forums, wikis and social media provide

game developers with indicators of what works and what does not, but the amount of data provided by users can pose a problem, as analysis can be time consuming. In order for this type of information to become useful for a company, it needs to dedicate a large amount of time and resources to gather and analyse the data. This is not always profitable and the data is not always reliable. Another way the companies gather information through users is by involving them in the research and development phase where tests, such as alpha- and beta-test, provide indicators of what works and what can improve in the game. A programmer stated:

“I think companies listen to players, but as a company you have to be very careful because players normally don't know what they really want and the players that scream are normally the ones that are unhappy. So you might follow their opinions, and alienate everyone else.”

Crowdfunding through platforms such as Kickstarter and early access has quickly become a popular way of generating additional income over night. The users invest both time and money into projects they want to see finished and this investment gives the backers a personal relationship with the development company. This influences the production as a sense of obligation towards the backers is created through this relationship. However, according to one of the game directors crowdfunding might be reaching its peak as less users are backing projects and now are waiting to see results from the developers.

“Crowdfunding has invested a lot in the gaming industry, but there has not been many products released yet. The crowd wants to see results, but it often takes one to two years before the games are finished ... so the crowd becomes disappointed and will not invest in new projects.”

One of the project managers stated that this might not be the case as there is an increase in projects and the backers become more spread.

4.3.2 Video Game Companies

There is a strong collaborative culture in the game industry both internally in the company as well as externally. In the Norwegian game developing industry, companies and individuals share knowledge, technology and resources. As the Norwegian video game industry is small, the companies develop quite different games and therefore are often not in direct competition. This might alter as certain companies become more established and gain higher market positions.

To strengthen the industry, the companies seem to share knowledge and resources. One of the companies in the study hired another game development company to work on their project to increase the skills and knowledge in a specific department. Another company openly encouraged employees to work on external projects on their own time as it benefited the company in the long run through increased knowledge and skills. As stated by the CEO of one of the companies:

“An idea is not worth anything unless it is used by others.”

A programmer stated as well:

“It's a strange situation; we must help each other to kick start the industry in Norway.”

Outsourcing parts of the production such as animation, sound, testing and localization is common as it is less expensive and enables the company to benefit from external competence. This is a pure hire for skill job, freeing up valuable time and resources in the company, which directly applies to the project. Though it was expressed by several of the companies that they would prefer to have most, if not all, resources in-house.

4.3.3 Government and Financial Institutions

The Norwegian VGI struggle with establishing a strong market with international competition, which can generate sustainable profits. Despite public funding programs such as NFI and Innovation Norway, it is still a struggle to generate enough capital to fund an entire project. The amount the subsidy scheme granted by NFI is meant to cover the initial start-up phase of a project, from idea to finished prototype. To fund the remainder of the project to release, the companies need to invest time and resources to raise capital through private investment and external investors.

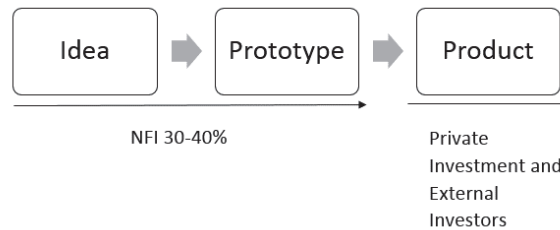


Figure 1 Example of funding of a project from idea to release

As there is currently a large focus on the Norwegian video games being culturally influenced and presented in the native language in order to receive funding, it can become difficult to reach international markets. These policies can therefore hinder innovative productions necessary for the industry to strengthen and grow. A solution seems to be alternative distribution and publishing channels. Also funding through alternate channels such as Kickstarter can provide the necessary capital to publish the games. This requires a great deal of resources and time to market the potential game to users, yet there is no guarantee of the success of the campaign. This can greatly halt the development process and even kill a project. One of the game director's commented:

"The biggest challenge when it comes to innovation is to raise enough capital to create what we want to create. Half of the resources goes to obtain additional capital."

This illuminates the difficulties Norwegian game development companies have to efficiently manage resources for larger projects. According to the project manager:

"The more time you spend on a game the more it costs and it is risky to put all your eggs in one basket. Therefore, we have two other short projects that we are working on."

4.4 Organisation

The companies participating in this study had different roles in management, but in general, it consisted of producer, director, and project manager. One person could inhabit all roles or they could be divided between several people. This depended on the size of the company. Management's main role was to set goals and communicate a clear vision for the project, guiding the teams in the development process. The goals and deadlines create boundaries to keep the team on track and working towards a common vision. Yet the development teams are given a lot of freedom to experiment with new tools and techniques and work across designated roles contributing to the final product. Failure is often not seen as a negative event and is encouraged as it leads to new knowledge and learning benefitting the company. It also provides room for interpretation and individuality from each member of the team, resulting in creativity and innovation. However, this can also hinder innovation in the company as miscommunication and interpretation can lead to undesirable results in the game unless tightly managed. As stated by a CEO at one of the companies:

"We are not very rigid, but we have phases and deadlines we relate to, it is quite an organic process. The team feels ownership and this is important so that everyone takes responsibility for the results."

A project manager from a different company expressed:

"I do not oppose change, but I think it is impossible to design a game on paper. Many things happen along the way and it is a long process. As the project manager I try to facilitate change rather than oppose, but question the choices."

The teams of developers consist of highly technical and creative people collaborating in open environments. It is a complex mixture of programmers, artists and designers that interact and influence each other, sharing knowledge beyond their designated roles. As the video game industry in Norway is quite small the competition for skilled people in the industry is hard. Many of the senior developers in the industry acquired their experience from Funcom, the largest game development company in Norway, and have now set out to start their own game development studios or joined existing ones. Newly educated people are also recruited. The teams are often self-driven and feel ownership of the projects through complications with

communication across teams or knowledge groups where misunderstandings occurred was common. One of the design directors stated:

“Those who have worked with game development before are very self-driven and take control of things, while those hired directly from school are more uncertain. The team is very self-driven except the artists. They found it difficult to organize. We had external artists and our own. It differed very between who understood what was going to be made and those that did not.”

An interesting observation was that most of the companies did not express having a clear innovation strategy or goal; this was inherent in their culture and considered to “just happen”. When asked about their approach towards innovation, a common answer was: *“We do not have a goal to innovate, but we do it anyway.”* The process of innovation is seen as a natural part of the creative environment and development process. It is not necessarily a conscious part of the strategy of a game development company, but a result of the organic process and interaction between management and developers. This is enhanced by the flat structure and open boundaries of the companies leading to knowledge crossing between knowledge groups such as programmers and designers. One of the project managers explained it as:

“Creating something is a driver. Not economically motivated. It’s the combination of all the talents of the group that makes it interesting. Progress and seeing it turn into a working game is motivating.” – Project manager

5. DISCUSSION

In this section the four broad categories, market, technology, environment and organization, are discussed in the context of interactions to provide an answer to the research question, *What patterns of interaction characterise the innovation process in the Norwegian video game industry?* First, a table summarising the interaction and patterns within each category is presented followed by a discussion of each.

5.1 Patterns of Interaction

The findings reveal several challenges occurring between different actors in the game development companies. These problems can be presented into four broad categories highlighting a pattern of interaction explaining the causal effect they have on each other and on the innovation process of the company. In this paper, the definition of patterns of interaction is a combination of Christopher Alexander’s (1977) definition of pattern and Wikipedia’s (2014) definition of interaction, resulting in: *“A reusable solution to a commonly occurring problem between two or more actors that interact with one another in a given context.”*

According to McGee (2007) designing patterns requires identifying conflicting problems (human concerns), recognising a feature that resolves the problems, and specifying the Pattern’s context (the when or where that this Pattern is appropriate). The table below addresses these three sections in correlation to the interactions within each category.

Category	Problem	Pattern	Context
Market	If the market cannot sustain a growing industry, the industry will halter.	Therefore, take advantage of social web platforms to generate value and establish relationships with potential users in national and international markets.	When companies are dependent on the international market.
Technology	If a company only relies on own technology then the development process might be hindered and the product will not reach the users.	Therefore, combine own technology with leading standardised technology to be flexible and productive.	When there is rapid technology change influencing the development process.
Environment	If a company does not interact with external actors, the company might lose valuable and costly information to respond to the volatile market.	Therefore, interact and build relations with external actors to position the company and the product in the market.	When smaller companies are trying to establish in an uncertain market.
Organisation	If the company does not have clear management presence providing boundaries and goals in the process, the teams might lose focus and development halter.	Therefore, have clear roles, set boundaries and clear goals to guide the teams, but let the daily process be flexible and organic.	When the organisational environment is highly creative.

Table 3 Patterns of Interaction

5.2 Market

Changes in markets and the competitive strategies of large companies have increased the pressure on smaller companies to focus on innovation, innovation capabilities and innovation management (Hotho and Champion 2011). Developing products that are innovative and generate interest in the market is challenging. According to the findings, the greatest challenge in the Norwegian video game industry is generating capital and establishing a strong market with international competition. Despite public funding programs such as NFI and Innovation Norway, it is still a struggle to generate enough capital to fund an entire project. One wishes that private investors were increasingly active to support the industry, either through loans or fund. Innovation Norway is an important actor in that regard (Jørgensen 2009). Alternate funding through social platforms such as Kickstarter can provide game development companies with the necessary capital to publish the games and extend to an international user base that can increase the likelihood of publication. Once the funding goal is achieved, the platform transforms into an information channel between the game development company and the backers providing the company with a platform to market the game, reaching backers across the world. However, using these platforms requires a great deal of resources and time to plan and implement the campaigns, yet there is no guarantee of the success of the campaign. This can greatly halter the development process and even kill a project if the company is completely reliant on the funding. It is therefore essential that the games provide something new and innovative that can drive the marketing and generate interest of potential backers.

5.3 Technology

A technological interaction between console manufacturers and game development companies is defining as console manufacturers are dependent on the availability of compatible games, while the success of game developers and publishers depends on the installed base of compatible consoles (Dietl and Royer 2003). When new console technology is introduced on the market, it creates innovation possibilities for the game developers. The vast amount of consoles from PC, Playstation, XBOX, and mobile, reaches a larger user base from casual to seasoned. It shows therefore a connection between internal technology developed by

the company and that of standardised technology developed and distributed by external companies. However, regulations and standards set by the consoles can hinder development of innovative games. With the rapid development of console technology, new standards are introduced quicker than the production of one possible game. Forcing the game developing company to adjust accordingly or risk losing their market position for that game.

A combination of standardised development tools, such as Unity, and technology developed within the game development companies are common. As tools for developing video games have become less expensive and more user friendly, fewer companies develop entirely their own tools. Instead they invest in a “platform product” (Baldwin and Woodard 2009) which is suitable for their purpose and create modules to customise its use. This provided that the standardised platform is flexible at its core allowing external modules to interact. In this case platform providers can hold dominant positions in the industry, but they also face the challenge of managing the evolution of the platform by cultivating an effective ecosystem of enablers and complementors (Basole 2009). Findings show that the game development companies adjust to this evolution through a combination of standardised platform technology and technology developed in-house by the company. This provides flexibility necessary to adjust to changes in external technology as well as keeping stability in the development tools. Shaping the modules surrounding a stable core of the system.

5.4 Environment

Knowledge sharing interaction among companies is shown to result in competitive advantage and significantly influence innovation (Enkel et al. 2009; Miller and Côté 2008; Schilling and Phelps 2007). Findings show there is a strong collaborative culture in the game industry both internally in the company as well as externally. In the Norwegian game developing industry, companies and individuals share knowledge, technology and resources with little competitive focus between the parties. This is to strengthen the growing industry and might alter as certain companies become more established and gain higher market positions.

Another external interaction is between the game development company and the users. Users are often involved in the research and development phase where tests, such as alpha- and beta-tests, provide indicators of what works and what can improve in the game. This interaction with the users ensure to some degree the success of the game in the market as video games are interactive artefacts, and consumer satisfaction and technical performance are not established until tested by users (Bakhshi and Mateos-Garcia 2010). Technology platforms such as the internet has created new ways for companies to interact with users, through forums and company websites. These provide an arena for users to communicate their wants and needs towards the games and the company as well as giving the companies the ability to respond. However, these arenas are mostly a one-way street where users provide information and the companies collect what is of relevance as defined by the companies themselves. In order for this type of information to become useful for a company, large amount of time and resources need to be dedicated to gather and analyse the data. This is not always profitable and the data is not always reliable. However, this form of interacting with customers is an important element to understanding the innovation process (Miller and Côté 2008)

5.5 Organisation

The VGI is a highly creative and fast-paced industry, requiring competent and complex teams of programmers, designers, artists, musicians, producers, testers, and project managers (Bygstad and Waal 2013). Findings show that development teams work towards clear goals set by the management in each project. These goals are facilitated from management to the teams throughout the projects and adjusted in each iteration to adapt to the changes and new knowledge gathered. This process is flexible and provides room for interpretation and individuality from each member of the team, resulting in creativity and innovation. However, this can also hinder innovation in the company as miscommunication and interpretation can lead to undesirable results in the game unless tightly managed. A balance is necessary between an organic strategy to stimulate innovation and mechanical strategy to be able to make use of its innovations (Cadin and Guérin 2006). As pointed out in the findings, innovation is not necessarily a conscious part of the strategy of a game development company, but a result of the organic process and interaction between management and developers.

6. CONCLUSION AND FURTHER RESEARCH

In this paper, the question posed was *What patterns of interaction characterise the innovation process in the Norwegian video game industry?* Based on a qualitative study through engaged scholarship with four game development companies and key informants, four patterns of interaction are identified within the categories *market, technology, environment and organization*.

By identifying these patterns, it can provide an understanding of how the complex industry and its actors interact, as well as identify how the innovation process is reinforced or hindered. By fostering the four identified patterns of interaction, the company can increase its innovation capability and thereby increase competitive advantage.

6.1 Limitations

There are some limitations to this study. First, the study only looks at four game development companies and a small selection of informants, which cannot represent the entire industry. It can be used more as an introduction to possible patterns for further study in the Norwegian VGI. It would also be interesting to do similar studies in other countries for comparison.

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Innovation in Game Development: IT Enablement and Affordances on Kickstarter

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Abstract

The rise of social media platforms has changed the nature of interactions between computer games companies and players. Computer games companies have greater access to information on their needs and wants as they share information and engage with players in the development process. The purpose of this paper is to highlight how crowd-funding social media platforms, in this case Kickstarter, can enable computer games companies and players to produce and utilize knowledge that can facilitate the game development process. In this paper, the Pöppelbuß and Malsbender conceptual framework and the IT enablement model by Jarvenpaa and Tuunainen are combined in order to evaluate how computer games companies can interact with players and accelerate games development using Kickstarter. The results show that Kickstarter is a useful platform for gaining access to a dedicated user base willing to share their knowledge. Kickstarter enables companies to build strong relationships with their backers via the processes of informing, responding and promoting response. Kickstarter helps to integrate the role of the games company with that of the users by enabling both parties to engage actively with each other, rather than the games company taking a passive role of simply gathering feedback from players.

Keywords Games development · IT enablement · Social media platform · Innovation

1 Introduction

Social media platforms have enabled companies to gain deeper, more informative insights into the wants and needs of different user bases. This has led to more innovative solutions as companies can gauge the collective ideas of users (Pöppelbuß and Malsbender 2013). The challenge for companies is to manage information efficiently and to apply it so that the company gains value. Users of social media

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platforms share both positive and negative information with ease. They actively use platforms to communicate their ideas, problems and frustrations. However, the amount of information that emerges can be overwhelming and unmanageable, and much of the constant stream of individual opinions and information might appear insignificant or distracting to company managers who are trying to keep pace with the market (Mandviwalla and Watson 2014). However, social media platforms have become a mainstay in society, and companies are expected to engage with consumers through these channels in order to gather market data and sustain their long-term competitiveness (Lettl 2007).

The rapid advances in social media, mobile technology and information management have driven companies to adapt to these technological trends, which in turn offer access to a great amount of information, networks, and new means of collaborating and connecting with both consumers and investors; by doing so, companies can become more innovative and competitive (Cherinka et al. 2013; Mandviwalla and Watson 2014). Company managers must be able to use social media proficiently in order to network, and to build a company brand and reputation. According to Mandviwalla and Watson (2014), they must be able to facilitate human capital (by monitoring consumers' reactions to products and services), facilitate organizational capital (by improving customer service) and be able to escalate sales using social media tools (economic capital).

Companies are now expected to have a social media presence, and be highly responsive and attentive towards their consumers online (Crawford 2009). Although the physical and financial costs of correspondence and market research via social media are perceived to be low (Sawhney et al. 2005), a corporate social media presence is not always easy to maintain as the process of reviewing and responding to customer feedback is time-consuming; companies need to observe real benefits from engaging on social media platforms.

Turning consumers' opinions into innovative solutions is one way of creating value. Although there has been much public and research interest in crowdfunding, many questions around crowdfunding and innovation remain unanswered, both in terms of product success as well as the way in which crowdfunding shapes an organization's future innovation efforts (Stanko and Henard 2016; Nucciarelli et al. 2017). Although researchers have increasingly focused on user engagement and collaboration for innovation in recent years, there have been few studies into the influence of user knowledge on specific innovation activities, or on the ways by which IT platforms, specifically social media platforms, support these activities and generate business value (Sawhney et al. 2005; Pöppelbuß and Malsbender 2013; Blazevic and Lievens 2008; Hubavenska and Domingues 2015; Benitez et al. 2018; Magnusson et al. 2003). Further research is needed in order to determine the effects of crowdfunding in entrepreneurial innovation activities, information that could "guide entrepreneurs in the design of crowdfunding campaigns and provide accurate mapping of the different sets of interaction among entrepreneurs, crowdfunding platforms and the crowd to identify emerging business models and new forms of value creation" (Nucciarelli et al. 2017). Hence, this paper explores how the use of one social media platform, Kickstarter, enables computer games companies and players to produce and utilize knowledge for innovation. Social media affordances (Pöppelbuß and

Malsbender 2013) and the IT enablement framework for service innovation (Jarvenpaa and Tuunainen 2013) are used to determine how Kickstarter can enable greater innovation in games development.

2 Literature Review

2.1 Social Media Listening

Users possess a wide set of skills, experiences and interests, which are often unused sources of knowledge. Companies can innovate by drawing on this knowledge and capitalizing customer competencies (Blazevic and Lievens 2008). This can be managed through communication by and with users on online platforms and communities (Sawhney et al. 2005). Previous research discussing innovation and user involvement has focused on concepts, including lead users (Von Hippel and Katz 2002; Von Hippel 1986), co-creation (Näkki and Antikainen 2008), open innovation (Chesbrough 2006), and user integration (Piller and Walcher 2006).

Urban and Hauser (2004) presented the concept of “listening in” on customer dialogues during Internet searches. By monitoring customers’ activities online, companies can identify customer needs from a large user base, which provides the company with continuous up-to-date information, which enables opportunities for innovation. Crawford (2009) identified three ways in which listening can create value for a company: the company participates in a community and receives people’s opinions; it utilizes a rapid and lower-cost form of customer support; and, it gains a dispersed global awareness of how a brand is perceived by people, as well as information on consumer use and satisfaction. Pöppelbuß and Malsbender (2013) defined the term “sensing” as activities for discovering opportunities or impulses that trigger service innovation. This includes the gathering and management of information of various types and sources, including general information about economic and technological developments. According to Pöppelbus et al. (2011) and Plattfaut et al. (2013), in order to successfully manage sensing, three activities are necessary: Scanning (continuous and deliberate observation of internal and external impulses which require constant dialogue with customers, employees, and technology providers); Evaluating (an initial screening of ideas, opportunities or needs regarding general feasibility, customers’ willingness to pay, or degree of fit with corporate strategy); and, Detailing (identifying the precise function and value that an improved or new service is expected to provide to customers).

In order for a company to gain access to such information, its customers should be willing and able to share their knowledge. Three components are necessary in order to achieve this: social media, as an online environment suited for mass collaboration; a community, as a collection of individuals who come together to pursue a common purpose; and finally, a purpose, which draws people together in the online community (Cherinka et al. 2013; Sawhney et al. 2005; Hau and Kim 2011). Conventionally, the concept of listening has been a “one-way street”, whereby the company gathers information provided by users without much interaction. If the company treats users as passive recipients of innovative activity, they limit their

understanding of user-generated knowledge and lack the capacity to refine and enhance ideas and achieve potentially innovative outcomes (Sawhney et al. 2005). According to Crawford (2009), the act of listening entails both paying attention to what is being said as well as disclosing information. Hence, listening is a dynamic process of attention.

A more specific term is Active Listening, a concept first presented by Rogers and Farson (1957), whereby the listener understands, responds and remembers what is being said. Applying this to social media demands a greater amount of interaction with the users by responding to their questions and comments, as well as posting information such as product images and descriptions. Such information might show the development progress of a product, which is designed to attract a response from users, generating feedback and data that can be useful for the company. Feedback is both qualitative (i.e. what they like or do not like) and quantitative (such as the number of people using a product and the percentage who find it valuable) (Cherinka et al. 2013).

According to Blazevic and Lievens (2008), there are three roles users play during knowledge coproduction: passive user, active informer, and bidirectional creator. The passive user is unaware that their behavior and online presence is being tracked and used for development of products and services; the information produced by the passive user is representative of their behavior online, and provides the company with aggregated data of all users participating in the online community. Active informers are more vocal and identify problems with the information provided by the company; however, they do not deliver a solution to the problem, even though they are motivated by an expectation that their information will lead to better solutions (Blazevic and Lievens 2008). Nevertheless, active informers can benefit the company by revealing their perceptions and opinions about current products. Finally, the bidirectional creator (i.e. a content-contributing customer in an online community) identifies problems, provides suggestions and solutions to the company, and also responds to issues posted by other users in the community; by doing so, the bidirectional creator coproduces new knowledge (Blazevic and Lievens 2008). However, such users usually constitute a small minority of a company's user base, and the company needs to be aware that their opinions and ideas might not be representative of or pleasing to all the other users (Blazevic and Lievens 2008). According to Sawhney et al. (2005), members of virtual communities, such as computer game players, often show a high degree of involvement and even specific technical competence. Finding a suitable platform to support interaction between the company and potential users is important for facilitating the gathering of information, which can be applied to the innovation process.

2.2 Kickstarter as a Platform for Innovation and Co-creation

Customer interaction is now an important contribution to new product development as it leads to the positive outcomes of innovation initiatives, greater quality, and lower cost (Von Hippel 1986; Carbonell et al. 2009; Magnusson et al. 2003; Pöppelbuß and Malsbender 2013). The use of social media platforms in corporate

settings has increased over the years, and many companies have realized the value of integrating social media capabilities into their IT infrastructure in order to capture and utilize data and knowledge of their user bases (Benitez et al. 2018). Many social media platforms are interactive, open, widely available, commodity-like platforms “which afford openness and flexibility in bringing separate user experiences together; enabling social connectivity and monitoring of this connectivity; and allow for broad transparency and traceability of user content” (Jarvenpaa and Tuunainen 2013).

The social media platform discussed in this paper is Kickstarter, a global crowdfunding platform focused on bringing creative projects to life (Kickstarter). The platform is designed for creators to post their projects on the site in order to raise funds for development. Project creators choose a deadline and a minimum funding goal. If the goal is not met by the deadline, no funds are collected; this arrangement works as a kind of assurance contract. Fans, strangers, friends and family members pledge funding in return for rewards, and are therefore the project backers. Creators’ rewards differ from project to project, but often include copies or mementos of what they are producing (e.g. video games, DVDs, books, clothes) or an experience unique to the project such as a character voice in a movie or game (Kickstarter). There is a risk for backers in that there is no guarantee that the projects will be finalized, that the money is used to implement their projects, or that the completed projects will meet backers’ expectations. Many backers become personally involved in the projects as they gain an “inside look” into the development process, and make a personal contribution towards making the project succeed both financially through feedback and testing. The backers are no longer mere recipients of the product, but financial investors who are directly involved in the development process and its success.

There might also be a sense of obligation for the developers to listen and respond to, and implement the ideas and suggestions provided by backers, as those in turn are financial investors. However, not all developers hold this perception. For the company running a campaign, crowdfunding platforms are a possible source of funding for product development. But the value of the platform not only has a financial dimension as the platform also provides backers with an arena for feedback, ideas, and word-of-mouth promotion of the product, which can be harnessed by the company to create value (Stanko and Henard 2016). The platform also enables project creators to post updates about the progress of the project, including videos and images. Researchers have shown that the more active a company is on posting information and updating backers throughout the development process, the more responsive and dedicated its backers will be when engaging in the innovation process (as opposed to passive monitoring) (Stanko and Henard 2016). It has been shown that the type of content posted can greatly influence the engagement of backers: more concise posts containing images, screenshots and videos are more likely to stimulate interest and responses (Rousvoal 2014).

Through the Kickstarter platform, a company can set up tiers containing rewards of different costs in order to attract backers. A creator needs to establish tiers that contain attractive rewards for reasonable prices in order to attract as many backers as possible and meet their target. However, Hau and Kim (2011) showed that this

type of rewards system might impede knowledge sharing with users; they advised that, in order to foster knowledge sharing, a company should convey a shared vision and goal with their users, who are interested in sharing innovation-conducive knowledge. On the other hand, Sawhney et al. (2005) claimed that well-designed incentives could have a positive effect on collaborative idea generation.

Backers of Kickstarter are often experienced users and also assess these projects using expert knowledge, and are more vocal when engaging in the development and innovation process. Backers can make a significant contribution towards the quality of future products (Mollick and Robb 2016). Crowd-funding is not without its risks: it might be time-consuming and strenuous and, if not done correctly, will amount to a substantial waste of time and money, which demotivates both the backers and the company (Mandviwalla and Watson 2014; Stanko and Henard 2016). Stanko and Henard (2016) prescribed three recommendations for a successful crowdfunding campaign: “1. Be open to insights from backers; otherwise much of the value of the crowd becomes neglected. 2. Crowdfund early in the product development process as backers want to participate in the process. 3. Update backers often regarding the product development process, and ask them to share their opinions.”

3 Theoretical Framework

3.1 IT Enablement and Facilitating Conditions

According to IT Enablement theory (Nevo and Wade 2011), an IT-enabled system comprises IT assets and organizational resources in a synergistic relationship with emergent capabilities. IT enables companies to generate business value through capabilities such as flexibility, supply chain integration, talent management, organizational learning, and knowledge management (Benitez et al. 2018). In relation to user and community-driven innovation, IT Enablement Theory focuses on increasing company performance by identifying facilitating conditions that accommodate both generativity and control (Jarvenpaa and Tuunainen 2013).

Generativity emerges when users and communities engage, learn and innovate, and generate value through the use of interactive IT resources such as social media platforms without any direct help from the owners of the original resources (Tilson et al. 2010). It can lead to “a capacity for rejuvenation, a capacity to produce infinite possibilities or configurations, a capacity to challenge the status quo and think out-of-the-box, a capacity to reconstruct social reality and consequent action and a capacity to revitalize our epistemic stance” (Avital and Te’eni 2009). However, it can also involve actions that undermine the company’s business goals, and lead to a negative outcome (Jarvenpaa and Tuunainen 2013). When a company has a social media presence, it is crucial to pay attention to the way in which communication is managed as infrequent or negative responses will discourage and irritate users, who will in turn spread bad publicity via word-of-mouth (Rousvoal 2014). Jarvenpaa and Tuunainen (2013) included the need for generativity as part of the IT enablement model (Fig. 1) to address user and community innovation activities. Generativity is produced by open and flexible affordances of IT assets, flexibility, procrastinated

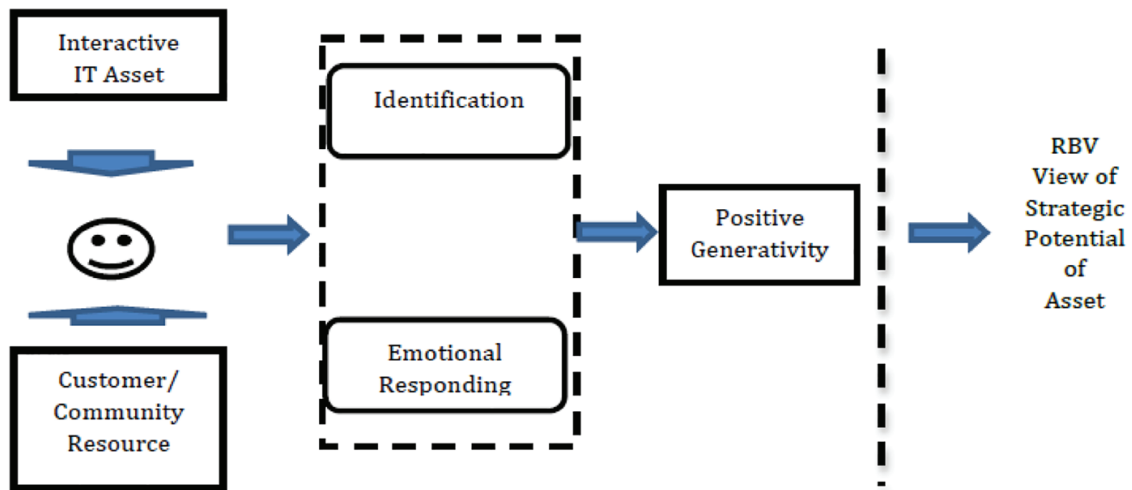


Fig. 1 IT enablement model by Jarvenpaa and Tuunainen (2013)

binding of form and function, recasting of roles and their scope, and unprecedented volume of digital traces (Yoo et al. 2012; Jarvenpaa and Tuunainen 2013).

Two facilitating conditions were presented by Jarvenpaa and Tuunainen (2013): users' identification with the company, and their emotional response to the IT asset. Through identifying with the company the user “gain(s) an appreciation of specific organizational values, develop the abilities necessary to function within a specific organization, gain an understanding of what the organization expects of them, and gain the knowledge necessary to interact with employees and other customers” (Jarvenpaa and Tuunainen 2013). This positively affects the extent to which generativity contributes to the strategic potential of the company. Emotional responses involve the aesthetic design elements of interactive IT assets that can positively influence generativity; they include feelings of authenticity, pride, attachment and fun (Jarvenpaa and Tuunainen 2013). These feelings are communicated through the IT asset, in this case Kickstarter, and can be categorized into visceral feelings (such as satisfaction and pleasure, or dissatisfaction); behavioral feelings (predictions of and expectations about the product involving past experience, and expectations of future states and events); and, reflective feelings (a strategic-level response relating to some end goal, and influenced by experience, culture and social group) (Jarvenpaa and Tuunainen 2013). As social media hosts a large heterogeneous audience, companies need to find ways of managing the process in line with their goals and values. In collaborating with users, companies must ensure that users understand their role in the process and identify with the firm through that role. Bagozzi et al. (2012) identified three different foci of identification, which have material impact: the self as an individual entity (individualistic), the self as part of a social group (collective), and the self as a relationship partner (relational) (Jarvenpaa and Tuunainen 2013).

3.2 Social Media Affordances

The concept of affordances is familiar in psychology, industrial design and human–computer interaction. It refers to the possible objective actions existing in

a given environment (Zittrain 2008). Technology affordance refers to “an action potential, that is, to what an individual or organization with a particular purpose can do with a technology or information system” (Majchrzak and Markus 2012) (found in Yoo et al. 2010). An affordance is a possibility for action, whereby the possibilities arise from actions or behaviours leading to a particular immediate concrete outcome (Bygstad et al. 2016). Thus, the concept of affordance focuses on the relationship between technology and an actor in socio-technical contexts. Individuals must first perceive the action possibilities before they can realize them (Pöppelbuß and Malsbender 2013; Strong et al. 2014). Pöppelbuß and Malsbender (2013) presented six functional affordances based on previous research on social media affordances, which users can realize, and which are expected to have a positive impact on the innovation outcomes of a company (see Table 1). This is conditional on the company monitoring and analyzing activity on the social media platform, or even playing an active role in triggering such activity through a dedicated moderator (Pöppelbuß and Malsbender 2013).

4 Method

A qualitative case study approach has been used for this study (Miles and Huberman 1994). A Kickstarter campaign for a video game by the game development company FunGames (*anon.*) was chosen based on accessibility to the actual company, as well as high activity by both the company and its backers on the Kickstarter platform. Posts and comments from developers and users on the Kickstarter page were collected: from March 2014 to May 2016, 2616 comments and 47 updates from the company with comments in each update from the backers were posted. These posts

Table 1 Affordances of social media according to Pöppelbuß and Malsbender (2013)

Affordance	Description
Generating impulses (generativity)	Social media provides users with an interactive platform where they can get inspired by contents of others and generate impulses for service innovation
Presenting impulses (visibility)	Social media allows users to present their impulses for service innovation to the public
Discussing impulses (metavoicing)	Social media enables users to react on others' impulses, e.g., through comments, sharing, recommendations, or ratings
Editing the presentation of impulses (editability)	Social media allows users to update and refine the presentation of their impulses
Network-informed associating of impulses (association)	Social media allows for associating users with each other, individuals and impulses, and different impulses with each other
Storing impulses (persistence)	Social media allows users to keep their posted impulses accessible over time for later reconsideration

were first read to identify overall categories; then, using the IT enabling conceptual model framework (Jarvenpaa and Tuunainen 2013) and the social media affordances model presented by Pöppelbuß and Malsbender (2013) for sensing service innovations, the data was coded in Nvivo to three concepts: types of facilitating conditions, affordances, and strategic business potential.

5 Findings

Using both models, the data was coded according to these three concepts. This led to the identification of a new concept, *building relation*, which pertains to the relationships among the developers, backers and Kickstarter. Hence, the IT enabling model is expanded by introducing a new facilitating condition and adding Affordances as a step towards enabling the facilitating conditions (as illustrated in Fig. 2). The facilitating conditions are enabled by affordances of the Kickstarter platform, which lead to positive generativity and a strategic business potential. This is described in more detail below with case-specific examples.

5.1 Building Relation

The facilitating conditions behind building relation include a company and its employees, the type of response from backers that their actions provoke, and the way in which they communicate with the backers; all these conditions determine the extent to which that company builds and reinforces a relationship with its backers. During a Kickstarter campaign, a company adds information, such as reward tiers, an introductory video, and information about the game development team. These are vital for attracting backers during the start-up phase. The company must provide sufficient information, which enables potential backers to make informed decisions on whether or not to support the project. Preferably, one needs as many backers as possible to join in the project, so the information provided should be positive enough to motivate the backers. In the case of FunGames, information about the game, such as a trailer video, as well as concept art of the environment, monsters and characters,

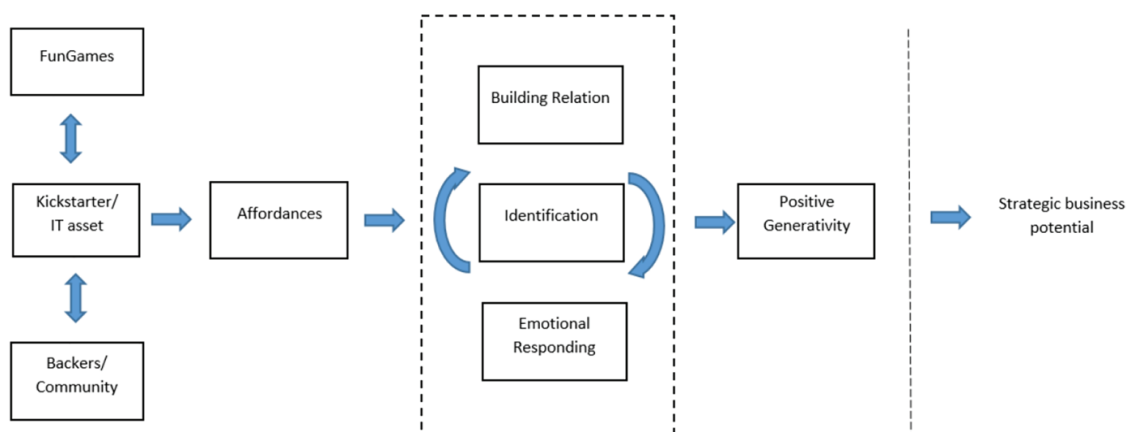


Fig. 2 IT enabling model with social media affordances adapted from Jarvenpaa and Tuunainen (2013)

were provided along with details about the development team and the game narrative. Several reward tiers were provided, ranging from \$1 to \$8000. Within the first 24 h of the campaign, the company had raised \$27k in pledges; this is an indication of interest for the game concept. Frequent updates were posted mainly by the CTO, who provided more information on the Kickstarter campaign progress, the game itself, and funding through government grants. As more information was shared through Kickstarter, more backers supported the project, and within 3 days the company had reached its \$40k target. The kind of information that is shared and the way in which it influences communication with the backers are interesting. Three categories were identified through the analyses of the updates and comments:

5.1.1 Informing

This relates to informative posts and comments by the company. These can include status reports, technical reports, progression reports, testing information, and notices on launch dates. For example:

Progression Report: We have had two major setbacks in October. First we had to upgrade Unity from 5.01 to 5.2 in order to launch on XboxOne and PS4. There were also quite a few bugs in Unity 5.01 that we just could not get around. So after careful consideration we upgraded, reluctantly. It is always scary to update any game engine software since you never know how much is going to break. To sum it up, we probably lost some 10–14 days doing this. Every scene had to be light baked again. We even had some terrain mesh disappearances to mention a few of the issues. On top of this, we had some other snags with animations that set us back a few days.

This information is simply addressed to the backers; there is no indication that the company expects a response from the backers. One could argue that providing this type of information helps the backers become more invested. It increases trust between the company and backers as the posts have a personal tone and provides transparency with behind-the-scenes information. This is in line with the third recommendation of Stanko and Henard (2016) for successful crowdsourcing campaigns (update backers often regarding the product development process). The Kickstarter platform allows the company to post this type of information; it provides the affordance of visibility, editability (being able to edit the information posted), and persistence (whereby this information can be archived throughout the campaign, thus enabling the backers to revisit the information from older posts).

5.1.2 Responding

This concept relates to comments the developers post in response to questions or comments from backers. By answering questions, or clarifying comments that are negative or misinforming, the company can mitigate negativity, which could potentially discourage prospective backers and undermine the trust between the company and the backer community. For example:

From backer: I'm pretty disappointed to hear that you're going to launch on Xbox One first. As a backer I would have preferred to get the game at the very least at the same time as the general public, but I don't have an xbox and don't want to have to buy one in order to play this game first. I'm a bit surprised that after the demo was on PC, you aren't focusing on PC as your primary platform.

From FunGames: I'm Sorry. We have never been in a position where we could do a multi-platform-launch. Our team is simply too small. So no matter what, we were bound to disappoint three of the four platform owners: PC (Windows,Mac,Linux), WiiU, PS4 and XboxOne. The only way we could do a multi launch is to postpone launch of the game on every platform until all platforms were ready for launch. Since we expect it to take one extra month work per platform (hope we can do it faster) that would delay the initial launch with up to 3 months. If we had the cash flow to wait making money to pay salaries, we actually might. Since marketing wise it is much better to promote the game when it is available on all platforms. On the other hand, we are super happy and grateful that we at all get a chance of launching the game at all. Had it not been for our wonderful and patient backers we would never have gotten this chance as we would have folded 18 months ago. Also regarding the choice of starting with one of the consoles vs PC/Steam, please check kickstarter update 40 where I explain the rationale behind this. It is not completely set in stone, but with my current knowledge it is the best decision for the game and the company.

As the example post shows, the comment from the backer is quite negative, pointing out a perceived flaw in the launch plans for the game. The company responds by providing a reason for those plans, as well as complimenting the backer's efforts and referring to a previous post for more information on the issue. This shows how the Kickstarter platform affords the company the ability to discuss impulses (metavoicing) from the backers through comments as well as draw on previous information posted relating to the issue (persistence). This in turn leads to more comments and questions from backers. As trust is built through good communication, the backers become increasingly keen to share their knowledge and experiences on the subject, which strengthens the community.

5.1.3 Promoting Response

This process relates to posts that include visual information (such as images and videos from the game), or direct requests from the company to provide feedback (through, for instance, testing). An example of a post and a response to the post is provided here:

Company: We have just reached our first stretch goal which means that a secret megaboss will be implemented into the game somewhere! Our artists have each created a Megaboss concept sketch which you can see below [image].

Backer: Naaww, both look vicious but it's a bit disappointing to know that there exists a concept for a monster but we won't be getting it because we'll

only get one. How about combining them both to create an even more original monster than those two? Scorphant? The Scorpio design is definitely original but looking at the Elephant I get the feeling more than with the Scorpio that we're up against something big and powerful. I vote for the Elephant and for you keeping the boss a secret.

As the example post shows, the company shares an image of two different megabosses that it might possibly implement in the game, with the aim of obtaining feedback from the backers. The feedback could relate to whether the design is good or bad, or contain suggestions on its functionality or look or comparisons to similar games. In this example, the feedback concerned the look and feel of the megabosses as well as a suggestion of a new megaboss, the Scorphant. The affordance here is generativity, as feedback and impulses triggered by posts from the company enables the company to gather inspiration and impulses for innovating and improving the game. The visibility and persistence of the posts and comments affords the company the ability to evaluate impulses among different backers as well as between the post and its feedback.

5.2 Identification

The facilitating condition of identification concerns (1) the way in which backers identify with the company, (2) the company values, and (3) what is expected of the company in terms of their interaction with backers. During the Kickstarter campaign in this case study, the backers not only became financially dedicated to the project, but they used their knowledge of the project as well as other game projects to help answer questions by other backers or to provide suggestions to the company in relation to marketing, campaigning and game development. The company itself launched a "Ninja" campaign by recruiting volunteers from the backer community to promote their game on multiple social media platforms (Facebook, Twitter, YouTube, Google+, Instagram, Pinterest, and Reddit). This shows the way in which the backers supplied valuable information as well as being utilized by the company as a marketing resource for increasing visibility, which can lead to more backers supporting the campaign and community. All six affordances are relevant for the facilitating condition of identification as the backers are able to exploit the platform, by commenting on other backers' impulses, and by associating them with experiences with other projects, in order to present their own thoughts and ideas (visibility, meta-voicing, association, generativity). What is posted is visible to other backers and can be archived until the company chooses to delete or change the post (persistence, editability).

5.3 Emotional Response

As mentioned back in Sect. 3.1, emotional responses involve the aesthetic design elements of interactive IT assets (Jarvenpaa and Tuunainen 2013).

5.3.1 Behavioral Responses

Behavioral responses relate to the predictions of and expectations about the product; these are based on past experience and expectations of future states and events. In the Kickstarter campaign in this case study, the backers offered suggestions often by drawing on their own past experiences with other projects. An example is provided below:

Backer: I get the reasons why you'd want to focus on a single platform, but I have seen other games which after releasing for their primary platform continue to postpone other platforms, eventually cancelling them. I really hope that won't be the case here. It seems to me like the majority of people are excited for a good RPG on PC, and Steam is simply a much larger user base to release into than Xbox. At least from what I can see it would make a lot more financial sense to release for PC. It seems like there'd be a much wider audience to reach that way. Choosing the console with the smallest number of users just doesn't make a lot of sense to me.

The backers have a financial investment in the project, which increases their levels of dedication and feedback as they feel more empowered in the role of backer. The backers promoted the project as they sought personal gain from its success; over time, more backers joined the project and gained satisfaction through helping the company. The Kickstarter platform enabled the backers to present their impulses through comments (visibility) as well as discuss impulses presented by other backers or the company (metavoicing). They compared the proposed game with their experiences with other projects of a similar nature, as well as other past experiences (association).

5.3.2 Visceral Responses

Visceral responses relate to feelings of satisfaction and pleasure, or dissatisfaction. They are triggered by visualizations of images or videos. In this Kickstarter campaign, the updates from the company containing visual information, such as character and environment design, and videos of gameplay and mechanics, promoted a visceral response from the backers in form of likes and dislikes as shown in the quote below.

Backer: Man that looks great! Really fantastic—it's also amazing how you guys can get such a great looking environment from such a simple sketch. Using the prefabs to block it out, then adjusting that and the set dressing—oh man, the set dressing!—Just makes everything come together perfectly. It's super nice! Clearly, your workflow is crazy effective! I'm so glad I backed this project:D.

The Kickstarter platform enabled the backers to respond to visualizations instantly through comments and likes, thus providing the company with valuable

information about the design of the game (generativity, visibility). Other backers and the company are able to respond to, discuss and build upon these impulses (metavoicing) as they are stored over time (persistence). This also enables further generativity as people new to the campaign can view and reflect on the information presented on the Kickstarter page, and make a decision as to whether or not they like the project and want to become a backer.

5.3.3 Reflective Response

Reflective responses relate to strategies and end goals, and are influenced by experience, culture and social group. An example from the Kickstarter campaign is provided below:

Backer: Why are there so many PlayStation users here criticizing the Xbox One first decision? I'm personally looking forward to playing this on my Xbox One. To the Creator of the game, so long as those 'fixes and improvements' come to Xbox One as well in a future patch, I have no issues with providing feedback for you!

As the quote above shows, the backer responds to the other backers' complaints about the decision to release the game on the Xbox platform first (association) by mentioning that he owns an Xbox One console. He also advises the company not to neglect the upkeep of the game, advising them to make "fixes and improvements" after the game is launched. He infers that choosing Xbox One is advantageous as there are Xbox players who can provide feedback and advice on bugs and issues; this in turn may improve the game's suitability for other platforms. The Kickstarter platform enables the backers to respond and build on other comments (metavoicing), address the company directly with their opinions and impulses (visibility), and relate comments and experiences of others with their own in order to address a certain end goal (association).

6 Conclusion

The purpose of this paper was to highlight how social media platforms, in this case Kickstarter, can enable computer games companies and their users to produce and share knowledge that can drive innovation in games development.

While user knowledge plays an important role in the innovation process, there is more required of companies than merely "listening in" on users' online communications. Companies should play an active role by triggering and fostering responses from users, as well as treating the user base as a resource for marketing and networking. It has been demonstrated in this paper that Kickstarter is a useful platform for gaining access to a dedicated user base willing to share their knowledge. Kickstarter enables companies to build strong relationships with their backers via the processes of informing, responding and promoting. Those enable a computer games company to build strong relationships with the backers through the facilitating conditions of informing, responding and promoting response identified in this research.

This paper has expanded on the IT enablement framework by Jarvenpaa and Tuunainen (2013) by exploring the facilitating processes of identification and emotional response, which help integrate the role of the company with that of the users and facilitate generativity. A company needs to foster innovation by engaging with its products' users, rather than merely listening or scanning (Pöppelbuß et al. 2011; Plattfaut et al. 2013). The transcripts in this paper show a greater amount of interaction with users is required, including responding to questions and comments, posting information such as product images and descriptions, and providing company-related information such as the development progress of a product that promotes insightful responses from the users. This in turn encourages many backers into becoming more personally involved in projects in addition to providing financial backing, as they gain an inside look into the game development process, and personally contribute to making the project come to life via financing, feedback and testing. This is proof that the facilitating process of building relation also influences and to some degree enhances identification and emotional responses among the backers, which further facilitate positive generativity. The affordances identified for each facilitating process offer benefits to both companies and their backers. This paper serves as guidance for games development practitioners who aim to utilize the possibilities offered by crowd-funding platforms in order to increase their innovation capabilities and build stronger relationships with potential customers.

7 Future Research/Limitations

This paper is a case study of one Kickstarter campaign launched by one computer games company; therefore, its findings are not directly applicable to other campaigns or other social media platforms. Further, more extensive studies are required in order to determine whether the facilitating processes and affordances for other games companies, campaigns and other social media sites are similar. This paper does not go beyond the six affordances identified by Pöppelbuß and Malsbender (2013), and other affordances might be identified in future studies.

Compliance with Ethical Standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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“Whoever is Educated by Anxiety is Educated by Possibility” A Study of Creativity in Game Development

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Abstract

The video game industry is in the forefront of technology development, which is also the case of the game industry developers. Their work requires a high level of creativity as well as technological savvy. However, working in small start-up companies also includes a great deal of worrying and even anxiety, and we know little about how these feelings influence creativity. We investigate this research question, how do top video game developers exploit worry and anxiety in their creative process? Our empirical approach was a qualitative exploratory study of six video game companies and start-ups. To develop our argument, we build on the concept of anxiety, as developed by Kierkegaard and May. Our conclusion is that the particular existential situation of game developer start-ups, which are characterized by uncertainty and strong financial pressures, triggers worry and anxiety. We show in detail, somewhat surprisingly, how game developers were able to exploit even anxiety to devise creative technical solutions.

Keywords Creativity · Worry · Anxiety · Innovation · Game development

1 Introduction

The gaming industry combines technical excellence and creative skills, which reinforce each other. As Greg Satell wrote in *Forbes* (2014), digital technology enhances creativity by its plasticity and its ability to recombine. The result, as we can see in most creative industries, is a wave of innovation. It would be misleading, however, to describe these processes as smooth and harmonic. As the game industry matures,

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there is an ongoing tension between the companies' strategy of incremental innovation (new versions of established products) and the developers' creative ambitions (Tschang 2007). Creativity seems to flourish in some kind of *friction*, for instance Zhou and George (2001) found strong support that job dissatisfaction was strongly associated with creativity. Further, creativity is not limited to individuals; rather, creativity is closely linked to the context, and the interplay of individuals and their work environment (Perry-Smith and Shalley 2014).

An important context is the work environment of game developers. The most innovative part of the industry is the smaller firm and start-ups, often with only one product, and with young and enthusiastic developers and owners. It is well known that the odds for success are high, and that many of them will struggle for years or go bankrupt. This creates a situation of great uncertainty, which in many cases will lead to worries and anxiety, both at the individual and social levels. The relationship between anxiety and creativity is well known in art (for instance, in the myths of Van Gogh or Dostojevski), and the link between creativity and mental illness is a controversial topic in creativity research (Silvia and Kimbrel 2010). Tyrer (1999) defined anxiety as a physically embodied state involving mental and emotional distress, combined with a more diffuse sense of uneasiness about a coming event.

In this study we conduct a detailed investigation of video game developers in small firms, and how they deal with the relationship between creativity and anxiety. Our focus is not on mental illness, but rather how developers exploit the uncertainty of their employment into creativity. Our research question is, *how do top video game developers exploit worry and anxiety in their creative process?*

As our sensitizing device, we build on the works of Kierkegaard and May. Kierkegaard regarded anxiety as an internal human condition, rather than something forced on the individual from the outside. Kierkegaard presents anxiety as both destructive and generative depending on how we approach it; there is a dual force. In his seminal work (1980) he analysed the dual nature of anxiety; it can lead to frustration and paralysis, but also to creativity: "whoever is educated by anxiety is educated by possibility" (Kierkegaard 1980, p. 156). Rollo May wrote that we can understand Kierkegaard's ideas on the relation between guilt and anxiety only by emphasizing that he is always speaking of anxiety in its relation to creativity. "Because it is possible to create—creating one's self, willing to be one's self, as well as creating in all the innumerable daily activities (and these are two phases of the same process)—one has anxiety" (May 1996). In the same vein Tyrer (1999) wrote that anxiety is not something to be abhorred, for a world without anxiety would be a grey and boring place that would lead to frustration and torpor.

We proceed by briefly reviewing the video game literature, focusing on hard and soft innovation. Then, we review the research on creativity in psychology and in information systems research. Further, we discuss definitions and differences between worries and anxiety. In Sect. 3 we present our method and the six cases, i.e. small companies from the videogame industry. In Sect. 4 findings are presented, where we highlight that worries and anxiety both are associated with creative action, but that processes are different. We discuss our findings in Sect. 5, where we argue, in contrast to earlier research, that anxiety plays a crucial role in creative processes in the game industry.

2 Related Research

2.1 Video Game Development Process and Soft Innovation

The video game industry is regarded as highly creative with rapid technology development and a high turnover rate. The game development process is evolutionary and complex, consisting of multiple design iterations, prototype testing and frequent milestones, where new features and content can be added during the course of the development (Tschang 2005). The development team is usually heterogeneous and typically consists of a CEO, programmers, 2D and 3D artists, designers, writers and a composer. It is a mixture of highly creative and technical people working closely together on a common project, i.e. the game. The game is technically a software program that works on hardware platform, such as console, computer or mobile phone (Lê et al. 2013). Due to the inherent complexity, the computer games industry meets challenges in workflow across disciplines, requirement elicitation, project scheduling, highly unpredictable demand patterns, production processes that are difficult to monitor and control and parallel development for multiple platforms (Camelo-Ordaz et al. 2012; Musil et al. 2010). The network of actors involved in the game development industry includes developers, publishers, console manufacturers, distributors and retailers (Lê et al. 2013) as well as financial and government institutions.

To succeed in a highly competitive market, the developers need to create a game that contains something new to satisfy consumers' demand for novelty without straying too much from familiar features of the genre or original game (Tschang 2007). Hence, there is a great need for innovation in game development. The video game is a work of art that generates emotions and experiences when played by the users, as well as a digital product with many technical components (Choi 2011). Game development therefore involves both hard and soft innovation. Hard innovation involves digital goods and services, while soft innovation concerns changes in "goods and services that primarily impact on sensory or intellectual perception and aesthetic appeal rather than functional performance" (Stoneman 2010). Soft innovation can be interpreted as complementary and interrelated to technological innovation (Paiola 2010; Stoneman and Bakhsi 2009). According to Stoneman (2010) there are two facets of soft innovation: one being the aesthetic or intellectual appeal often found in the creative industries, and the other being functional aesthetics as seen in marketing. Creativity plays an important role in the success of a company's innovative activity, and the source of innovation lies in the creativity and innovator capability of people (Hotho and Champion 2011). It is seen as "complex constructions involving the production, conceptualization, or development of novel and useful ideas, processes, or procedures by an individual or group of collaborating individuals" (Müller and Ulrich 2013, p. 176). Soft innovation not only involves the creation of ideas but also making them into marketable products (Stoneman 2010).

The value of a video game is not certain until played as an experience product (Hawkins and Davis 2012). The player interacts and can immerse herself in the

story of the game and can experience “flow” states when overcoming challenges with different levels of difficulty in the game (Csikszentmihalyi 1990). This interaction and immersiveness is essential for the success of video games (Choi 2011), and the experiential dimension of game play is therefore difficult to conceptualize and represent, especially in early stages of design which influences the development process as testing becomes a necessity (Nandhakumar et al. 2013). This leads to the development of many prototypes allowing for rapid feedback on what is or is not technically feasible, showing the strengths and weaknesses of an idea (Lê et al. 2013). Achieving the desired user experience, therefore, involves not only organizing a diverse team with a high level of creativity and technical expertise, but also achieving the desired cultural and emotional features of the game (Nandhakumar et al. 2013). It is important to distinguish between hard innovation, which refers to technological aspects within the creative process, and soft innovation, which refers to new and original content creation. This analytical distinction stresses the fact that technical novelty (hard innovation) and content creation (soft innovation), though linked, should not be combined (Jónasdóttir 2018b; Lê et al. 2013).

2.2 Defining Creativity in Psychology and IS

The concept of creativity has been of interest in a number of disciplines such as psychology, business studies, arts, sociology, technology and many more. Creativity is found to be a quite complex human performance and occurrence, which according to Mooney (1963) can be approached in four different ways: (1) the creative environment; (2) the creative product; (3) the creative process; (4) the creative person (Taylor 1988). Kotler (2000) presents two types of creativity: aesthetic creativity and problem-solving creativity. The first describes creative’s such as artist and writers where they portray their personalities onto their products, and the second is scientists and businessmen who develop products to solve problems. Creative problem-solving is the mental process of searching for an original and previously unknown solution to a problem which is novel and provides value by clearly solving the stated problem or is appreciated by someone for whom the situation improves (Torok n.d.). On the other hand, rational problem-solving involves a systematic approach to define a problem, generate alternative solutions, decision-making, implement and verify the solution (D’zurilla and Goldfried 1971). According to Amabile (1982) a product-centred operational definition is more useful for empirical research on creativity as “any identification of a thought process as creative must finally depend on the fruit of that process—a product or response” (p. 1001). What motivates creativity is intrinsic motivation where personal interest and enjoyment of the creative activity are important. While extrinsic motivation is detrimental to creativity when it is imposed on them by others (Amabile 2012). Creativity is often combined or confused with innovation; thus, a clear distinction is important. The Product Development and Management Association differentiates between creativity and innovation (PDMA 2018) where creativity is the ability to produce work that is both novel and appropriate and innovation is the act of creating a new product or process. The act

includes invention as well as the work required to bring an idea or concept into final form. As such we can define creativity as the creation of novel ideas by individuals or groups, whereas innovation is the adaptation and commercialization of these ideas in an organizational context (Müller and Ulrich 2013).

In an organization creativity is often collective, moving through a development process that incorporates multiple specialist groups (Lê et al. 2013; Tschang 2007). Creativity in an IS context can be seen as developing innovative information systems or services (Müller and Ulrich 2013). Creativity is a process that is aided by technology to produce content and where idea generation and modification continuously occur (Lê et al. 2013). The video game industry is dependent on a high level of creativity as well as technological savvy. It differs from typical information system or software development process situations as there is a higher level of flexibility and more open ended in their content creation (Lê et al. 2013). As small game development companies often experience turbulent times, they need to be creative and resourceful in their work. Leonardi (2011) states that constraints on organizational routines can lead to technological developments which in turn impacts positively on the current routines. Mayer (2006) states that a set of constraints can foster creativity by shaping problems and providing clear challenges to be overcome. Creative and technological resources can represent an opportunity and a tool to gain control over challenging situations (Zackariasson et al. 2006). Hotho and McGregor (2013) define creativity in relation to Bourdieu's perspective of habitus, the social embodied, and field, a space of conflict and competition. They state that creativity is "the capability to challenge what is taken for granted in any specific field in order to challenge power relations and power positions within this, the possibilities of an agent to affect the field and to push boundaries of the field" (p. 113).

Panourgias et al. (2014) sought to explore the relations between creativity and technological innovation and the associations and articulations involved in this relationship, finding that the game developers' creative ideas lead to the development of relevant digital technologies, and the emergence of new game development practices. However, it is important to note that too many creative ideas at once can make decision-making challenging and ultimately hinder innovation efforts in organizations if not properly managed (Müller and Ulrich 2013). The growth of the video game industry is driven by a tension between forces for creativity and those for rational (e.g. business) interests (Tschang 2007). Understanding what occurs in this tension can lead to fruitful results in managing creative and technological development teams. The role of worry and anxiety, however, is not investigated in the extant IS research.

2.3 Anxiety and Worry in Literature and Psychology

"Anxiety may be compared with dizziness. He whose eye happens to look down the yawning abyss becomes dizzy. But what is the reason for this? It is just as much in his own eye as in the abyss, for suppose he had not looked down. Hence, anxiety is the dizziness of freedom" (Kierkegaard 1980). In other words, anxiety is to fear some future outcome we have little or no control over. It is the feeling we get

when we are met with all of the staggering choices we have in the vast sea of possibilities and then are forced to choose one. When met with adversity and the sense of risk, the level of anxiety increases and one can experience a weakened ability to effectively manage negativity and reduced personal feelings of efficacy (Lazarus and Folkman 1984). According to May (1996) “anxiety is the apprehension cued off by a threat to some value that the individual holds essential to his existence as a personality” (p. 189).

The concept of anxiety is commonly related to the concept of worrying. Worrying and anxiety do appear to be closely related, though should be seen as separate constructs. Worrying is associated with adaptive problem-solving and information-seeking strategies, and anxiety associated with psychological processes and coping strategies that are normally considered maladaptive, such as (1) poor problem-solving confidence, (2) poor perceived personal control, (3) responsibility for negative but not positive outcomes, (4) the tendency to define events as threats and (5) avoidance or emotion-focused coping strategies (Davey et al. 1992). Several studies indicate that worry is functionally separate from physical anxiety (Borkovec and Newman 1998). According to Borkovec et al. (1983) “The worry process represents an attempt to engage in mental problem-solving on an issue whose outcome is uncertain but contains the possibility of one or more negative outcomes. Consequently, worry relates closely to fear process” (p. 10). May states that fear is dependent on hope, and hope is dependent on fear. Both are a weakness of mind that does not appertain to the use of reason (1996).

Kierkegaard (1980) makes a connection between anxiety and creativity, stating that one would have no anxiety if there were no possibility whatever. Actualizing the possibilities will always involve both negative and positive aspects, destroying the status quo to pave the path for something new (Popova 2018). Entrepreneurs starting their own businesses or pursuing new ventures often do so during difficult circumstances and have to alter the status quo and forge new paths in order to succeed (Bullough and Renko 2013). Understanding what drives entrepreneurial activity requires understanding how individuals personally construct perceived opportunities (Krueger et al. 2000). The enjoyment of completing challenging tasks is associated with creativity and culture and fuelled by the anxiety of the individual (May 1996). According to May and Gaines (1985), anxiety is the source of all creativity. It is the driving force behind human evolution, our survival and the civilization we have today.

2.4 Summing-Up

Assessing the relevant research we find that an investigation of the role of feelings such as worry and anxiety can shed new light on the creative processes of game development. Creativity has been addressed in several game development and information systems studies (Hotho and McGregor 2013; Müller and Ulrich 2013; Panourgias et al. 2014; Tschang 2007), though never in relation to the concepts of worry and anxiety.

Inspired by the research of Kierkegaard and May we have developed some assumptions of the relationship between creativity and anxiety. Game development is characterized by a high level of creativity and technological development executed by artists (game designers, writers, 2D and 3D artists, composers) and software programmers. The game development industry has mostly small-to-medium sized companies struggling in the fast paced and highly competitive market. This makes it an excellent area to study creativity and anxiety in combination with the use and development of digital technology. We chose to conduct a case study in the industry.

3 Method and Cases

3.1 Method

We chose a case study (Yin 2014) as our research approach. A case study is “an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-world context” (Yin 2014, p. 16).

What we investigate in the case is what Maxwell called *process orientation*. Process approaches “tend to see the world in terms of people, situations, events, and the processes that connect these; explanation is based on an analysis of how some situations and events influence others” (2012, p. 29). They tend to ask *how x* plays a role in causing *y* and what the *process* is that connects *x* and *y* (2012, p. 31).

3.2 Short Presentation of the Video Game Industry and the Selection of Cases

The companies were selected from a replication perspective (Yin 2014), i.e. they were expected to reveal common (or differing) patterns. The selection criteria were that the case (1) was a development team in a small game developing company with (2) some success in the video game market. Identifying potential companies was done through information from the Brønnøysund Register, a Norwegian government digital register, the Norwegian Film Institute (NFI) and Joingame, a national resource network funded by the Norwegian Research Council, which gave an indication of funding amount, times funded, years active and profitability. By crossing these data, a list of most active companies was generated. The first author was granted access to six such companies. Interviews and observations were then done with the companies and informants who were open to participation in the study.

3.3 Data Collection

Data were collected over a period of 3 years, from 2013 to 2016. We conducted 27 interviews lasting 1 h in average that were completed in 6 different companies. The interviewees possessed different roles such as CEO, CTO, project manager, programmers, 2D and 3D artists, designers, graphic designers, a composer and a sound engineer. The interviews were recorded and transcribed. Documents and/or observations were used as supplement to the interviews.

3.4 Data Analysis

Data analysis was conducted in four steps, moving from text to explanations (Miles and Huberman 1994). First, the interview transcripts were coded, using open coding in the analysis software Nvivo. Open coding “provides insight into specific coding categories” and “casual conditions that influence the central phenomenon” (Creswell 2007, p. 161). We identified expression of emotional concerns, what they were worried about, as well as the solutions made by the developers. Two main themes for worries were identified: financial and adoption. We then performed axial coding placing the information into a table with the classifications of problem and context, worries or anxiety and whether it concerned financial or adoption problems. Axial coding involves “crosscutting or relating concepts to each other” (Corbin and Strauss 2008, p. 195).

From the axial coding we identified a large number of episodes describing worry or anxiety. We chose six key episodes, which were subjected to causal analysis where we identified which emotional responses of worry or anxiety lead to creative problem-solving and result. We then performed a contextual analysis to understand what role technology played in cause or solution of the problems. Our results were consistent throughout the data material (Table 1).

4 Findings

As seen in Table 2, we chose six episodes relating to worry or anxiety which led to creative problem-solving within the six companies. What follows is an introduction to the financial and game adoption worries in the Norwegian video game industry and an explanation of each episode in detail.

4.1 Financial Worries

The game development industry in Norway is characterized by challenging financial situations as most of the companies are start-ups with no regular income. It is difficult for the companies to get the money they need for game production both in terms

Table 1 Steps of analysis

Step	Activity
1. Open coding	Identifying key issues
2. Axial coding	Coding concerns as worries and anxiety, and classifying concerns as financial or adoption
3. Causal analysis	Analysing the output results of worries and anxiety, and analysing causal relationships
4. Contextual analysis	Understanding the role of technology
5. Evaluation	Assessing the results

Table 2 Overview of six episodes presenting worry or anxiety situations with creative results

Episode	Worry or anxiety	Financial or adoption	Problem and context	Creative twist	Results
1	W	A	Small company has little resources for QA testing	Using forums such as YouTube for bug reports	An increase in bug reports enhancing the quality of the game
2	W	A	Tools in the development platform are not available or are of low quality	New tools developed for unity	Increased efficiency in development
3	W	A	The platform systems are the same, but the routines are not. The console platforms are also highly confidential in terms of knowledge sharing	Creating dummy-guides	Increased productivity and better overview of the vast amount of information
4	A	F	The Kickstarter campaign was launched at the worst time in December	Redo the entire campaign with new launch in March and using dedicated backers as “Marketing Ninjas”	A very successful campaign reaching \$178,193, further motivated investors and NFI to fund their project
5	A	F	Broken features during upgrades lead to loss in time and resources	A new routine in which the lead programmer tests the patch	Increased stability of the development software
6	A	F	Marketing limited while waiting for launch date on XBOX	Using the Kickstarter campaign as a marketing platform	Increased marketing reach and funding

of income and financing. There are several government institutions that game development companies can apply for financial support whether it be loans or grants as well as network arrangements. The main actors are Innovation Norway, Norwegian Film Institute (NFI) and Skattefunn. One of the main public funding organizations, NFI, operating under the Ministry for Culture, provides as much as 75% funding for game development as long as the product meets three of the four criteria for a cultural product (NFI 2014). Small start-up companies benefit greatly from the financial support from NFI as it provides enough capital to get started (Jørgensen 2013). These two organizations together provide game development companies with enough capital to begin production, though not enough to become self-reliant. This requires a sustainable income and investments which many game developers struggle with (Jónasdóttir 2014).

Some of the companies have managed to get investors on board, though this is not an easy feat. Most investors are highly sceptical to supporting video game start-ups. They usually invest once the company can prove they have a competitive product on the market. One company reports that it has been a constant chase after financing where they have been at the verge of bankruptcy every 6 months for over 4 years. As the development time of one game commonly is between 1 and 4 years, this is a long time to spend insecure about the future of the company and employee situation. The time spent applying for financial aid takes time away from development and further delays the production. Some of the companies turned to the crowdfunding platform Kickstarter to try to finance some of the projects. The developers can post their projects as a campaign on Kickstarter in order to raise funds for development. A deadline is chosen, and a minimum funding goal needs to be met by the deadline in order for the company to collect the funding. Fans, strangers, friends and family members pledge funding in return for rewards, and are therefore the project backers (Jónasdóttir 2018a). The time and resources spent maintaining the campaign on Kickstarter challenge the game production, but is a necessity to gain the necessary income to support further production. Many of the above mentioned challenges are referred to by the developers as a catch-22 situation.

4.2 Game Adoption Worries

In a highly competitive international market, the companies face challenges in establishing themselves with their products. Gaining a market share requires games that are innovative yet familiar to entice users with something new and provide comfort of the known. Meeting customer needs both nationally and internationally is challenging as they are competing with both large AAA studios as well as small indie companies. Generally, supply and demand in this industry are very difficult to predict (Jørgensen 2009). Over the past decade the development tools and console platforms have rapidly evolved from expensive technology; only a few could afford to more affordable technology for the many. With the internet revolution the distribution of video games has become easier as well. This has enabled start-ups to develop and compete with the same technology and on the same platforms as large established companies. The major video game platforms are PlayStation, XBOX,

Nintendo, PC and mobile. There are two main development platforms used in the industry: Unity and Unreal. The game engines allow for third-party applications to be added to the platform enhancing its functionality. This is positive as developers can add functionality not provided by the platform distributor. Though many developers reported that it caused problems when there were updates from the platform as the third-party applications stopped functioning. This would lead to hours or days spent correcting the problems further delaying the project and increased resource spending.

4.3 Episode 1: QA Testing in Small Companies

The first episode concerns QA testing and small teams. The video games they develop are advanced pieces of software with a lot of functionality, e.g. graphics, mechanics, sound, hardware and more which need to be thoroughly tested. This is a tedious and resource-intensive process. Small companies do not have enough resources for a dedicated QA team, which often leads to the whole team performing QA testing of the game. The problem is that they are not able to balance the process where a part of the team does testing, while the rest works on other parts of the game or begin development of a new game hindering further development. This creates frustration among the developers. It can also cause a delayed release which affects their users and the budget plan. An informant in company B states that releasing on mobile platforms is “a tricky affair, with billions of devices to consider”. The developers worry that the game will contain a great amount of bugs when released to the users.

We only have five of us and suddenly our games go out to 1,2 million downloads and 600,000 users and within an hour they have done 600,000 hours of playtesting so off course we have had lots of bugs. - Company F

The developers often have to be creative with the resources available to them. Some of the companies simply outsource QA testing, though not all companies can afford to do so. This means they must find cheaper and readily available resources to properly test the game. Most of the companies’ report doing user testing throughout the development process. They provide an early sample of the game to test on a certain number of users which then report back to the company. This is a common method for testing among game development companies. The creative twist was identified with company F which reported some creative methods for identifying bugs that have been implemented as a routine at their company. They use social media such as YouTube and other forums where users actively post the bugs they find on their own accord, resulting in an increase in bug reports enhancing quality of the game.

“We’ve fixed several bugs where people have just posted stuff on videos and its great and the previous company I worked at they were massive, and they used YouTube a lot to find bugs. Your consumer base can now effectively be your bug testers and not only that, but they will show you your bugs. That’s what YouTube video capture is great for.” - Company F

4.4 Episode 2: Lack of Tools in Unity

The second episode concerns the development platform Unity and tools available to the developers. Most of the game development companies reported using Unity as their game engine and development platform. The problem developers report is that they often need a functionality that is not available through existing tools which slows down the development process. This results in frustration as certain procedures have to be repeated multiple times or cannot be done at all. The developers became worried that the game would suffer in terms of aesthetics or functionality when the technology cannot support the intended ideas. The creative twist is that the developers take advantage of the flexibility in Unity by developing third-party applications to the platform. Creating the missing tools themselves depends largely on the skills and knowledge of the developers, especially the programmers.

“Unity has lots of things in it from the get-go, but this has been a collaboration between programming and design all the time. If a designer wants something and does a task over and over again, and it is very cumbersome, then we can develop a tool that lets the designer get to the end result faster.”—Company F

This has resulted in highly innovative tools that greatly enhance their development process (e.g. an RPG toolbox) or give the game a competitive edge with never before used functionality (e.g. a dialog system).

“We are talking a lot with other gaming companies in Norway and many are interested in the dialogue tool we have created so we see it as an opportunity to put it into the unity’s asset store, so we can make money.” - Company E

4.5 Episode 3: Lack of Overview of Platform Specifications

The third episode concerns the console platforms and how they differ in routines for publishing. The problem is that each console has different technical specifications for the platforms and different continents have different routines and conditions for publishing. This adds up to an excessive amount of documentation. The developers express challenges with keeping track of all the different requirements for each console and how time-consuming it is to read all of the documentation for each platform. The creative twist was made by one developer who decided to write dummy-guides while going through the vast amount of documentation. This resulted in shorter versions of the documentations pertaining to the most important information and will in turn decrease the time spent reading the information in the future.

“I sat down and started writing my own “dummy-guide.” Now that I have a couple of “dummy-guides,” I’ve started sharing them with other people that might be interested because getting an overview of how all of that works is daunting.”— Company F

4.6 Episode 4: Unsuccessful Launch of Kickstarter Campaign

The fourth episode concerns launching the Kickstarter campaign at the wrong time of the year, i.e. December. Company F had trouble gaining funding for their project. It was a high anxiety situation as the company would go bankrupt after New Year if they could not get funding. This situation is reported as a common problem for several of the game development companies in the Norwegian industry.

“We went unpaid until January-May. Leaned on savings and severance packs.”
– Company E

“We do not have an extremely good economy so if you go very much over budget it will create a lot of problems over time therefore, we must keep the schedules very tight.” – Company A

To address the issue of eminent bankruptcy, company F decided to launch a Kickstarter campaign to fund part of the project through crowdfunding. They launched the campaign in December with no previous experience from crowdfunding. This resulted in a failed campaign not reaching their goal.

“For us, it was such a desperate attempt to get some more capital and run the Kickstarter before Christmas. While we ran the Kickstarter, it became clear that we had done a sale of an old IP so we got over half a million, so we also made an issue, so we got a little more investment capital and we had enough to live in March. We did not have it when we started the Kickstarter, which made us start the Kickstarter, and when we had the money, we chose to postpone it and make a little more and do it at a better time.” – Company F

The problem turned out to be the time of launch. The CEO came across an article stating the worst and best time to launch a Kickstarter campaign which showed December to be the worst and March being the best. The creative twist was to remove the current campaign, rework it and relaunch in March. Relaunching was unheard of by other companies. They improved the campaign greatly by changing the focus from informing backers about what they gain to promoting the game.

“If you spend time explaining things about what you get for pledging, rather than spending time communicating how cool the game is and how you work to create new cool stuff, and get the backers excited about it, it is clear that you get a completely different focus... So, by having everything in place, we can run the Kickstarter where we focus on where we are going with the game, the vision, the dreams, and all that is exciting, then it is clear that it will be a completely different campaign.” – Company F

They employed a creative solution such as “Marketing Ninjas” as well.

“With the Ninja Task Force we will systematically work across all social media. We will target games press, forums, bloggers etc. and overwhelm them with enthusiasm so more people can get their eyes on [the game]» - Company F

These situations become lessons learned for other companies as well.

“We learn from others mistakes. E.g. Kickstarter and [Company F]”. – Company E

4.7 Episode 5: Loss of Time and Resources

The fifth episode concerns upgrades from the Unity platform and how they often lead to broken features that had to be fixed. The problem reported was that third-party applications added to the platform Unity has a risk of breaking when new updates are released and implemented. This can have serious ramifications for a company as it can greatly affect the development process and progression. As one company stated:

“So, there were dark days for a while, like 5 months where all the lighting... [the CEO] was here at crazy hours trying to get lighting set. It was horrible. That’s the downside of a third-party system.” – Company F

The anxiety lies in the loss of time and resources while everything is being fixed. The company is small, with a little over 10 employees, and had little financial slack at the time, which led to this situation escalating to a crisis as it used a lot of time and resources not available to them.

“Unity has clearly been the biggest problem when it comes to things that have to be re-done. Also, we have tried not to upgrade, but then we are forced to upgrade. So, it has just opened a pandora’s box of things that have to be re-done. It’s not just that I have to go back to bake the light again in every scene, everything looks different, so you have to go about all the lighting in a different way. It takes a long time per scene and we have over one hundred scenes.” – Company F

“One of the problems we have is being a small company, you can’t stagger the process, which would be ideal. You’d have the art team working on the next title long before the rest of the group has started working, and that’s what we hope we can get into now.” – Company F

The creative twist to avoid situations, where large parts of the game need to be re-done during upgrades, was to implement a routine where their lead programmer installs the upgrade, tests for issues, fixes potential issues and then rolls out the upgrade to the rest of the team. This way they avoid major setbacks and gain control of the updates, and the lead programmer has a good overview of the system and process.

4.8 Episode 6: XBOX Marketing Restriction

The sixth episode concerns constraints on marketing while waiting for the launch date on the XBOX platform. This problem was specific to company F, as they had an agreement with XBOX through their Games with Gold program giving them

the exclusive rights to the game for 1 month before launching on other platforms, excluding Steam, a digital distribution platform. Hence, the company had to follow their specific requirements for marketing, and was very limited to talking about the game.

“Marketing ahead of time was really limited because we were basically on Xbox’s schedule, and they weren’t giving us much information to work with. So, if we had the game certified by Day 1, we might get released on Day 30. But that certification process could take anywhere between two and four months. We couldn’t start building a marketing campaign without a solid launch date. And it’s not as if, say, we got certified on Day 1 and we wanted to release the game on Day 2, it wasn’t up to us. It was up to them when they could squeeze it in and which month.” – Company F

As the game had been funded through Kickstarter, they had about 4500 backers who were eager to see the game launch. This created anxiety in the management as the marketing of the game was put on hold for an uncertain amount of time and they had backers from Kickstarter to keep happy. This could have devastating results as the company and the game were very reliant on the funding received from the Kickstarter campaign. The creative twist was the company’s decision to use the Kickstarter platform as an alternative marketing channel. Though they were limited in what they could share of information to these backers, they were able to provide them with continuous updates on the process as well as some screenshots and trailers from the game. They also ran an alpha test to get direct feedback from the users. They managed to maintain the backer’s interest during the 7-month-long certification process. They then encouraged the backers to spread information about the game through word-of-mouth marketing once the game was released. This resulted in an increased marketing reach as the backers promoted and recruited more backers which in turn gave an increase in funding.

4.9 Key Findings

In this study we identify six episodes where the subjects experience worries or anxiety about a problem and manage the negative situation through creative solutions. We identified two main themes causing worry or anxiety for the Norwegian game development companies: *financial* and *game adoption*. Further, we found that game adoption problems led to situations of worry, whereas financial problems led to situations of anxiety among the developers and management. This was a common pattern overall. Worry seems to be characterized by a situation which is not critical or imminent, giving the developers time to address the problem and work out a solution. In the case of situations prone to anxiety, we found a critical pressure on either the product or the company in terms of its survival. The uncertainty of the outcome and the need for a quick solution promoted creative solutions. We found that the technology could be both the cause of worry or the solution to the problems. We found that the developers, both management and employees, expressed a personal dedication and ownership to the company and the game.

“When you have a team of 200 people, you sort of feel more detached. You care about your part of the game but everything else sort of doesn’t matter, so it just becomes just like any other job really. Whereas, here, I actually sort of care about how the game’s received and stuff. Whereas, at [the other company], I didn’t really give a toss whether the game got good scores or not...”
– Company F

5 Discussion

We then return to the research question, *how do top video game developers exploit anxiety in their creative process?* We answer this by discussing previous research on anxiety and creativity with our findings from the Norwegian game industry. We elaborate below on how our findings contribute to new insights on anxiety and creativity theory and provide a practical guidance on how to exploit anxiety to find solutions in game development.

5.1 Theoretical Contribution

We have found that game developers and managers experience various situations characterized by worry or anxiety. The most prominent situations were found to be influenced by financial or game adoption struggles. Previous research presents a divided view on the relation between worry and anxiety and the level of creativity and problem-solving. One stream of the literature states that worry and anxiety are opposite; worrying is associated with adaptive problem-solving and information-seeking coping strategies, and anxiety independently associated with psychological processes and coping strategies that are normally considered maladaptive (Davey et al. 1992). With increasing feeling of anxiety one can experience a weakened ability to effectively manage negativity and reduced personal feelings of efficacy (Lazarus and Folkman 1984).

We do not challenge these distinctions, but our findings indicate that the picture is more nuanced. In line with the work of Kierkegaard (1980) and May (1996), our findings show that anxiety (as well as worries) is a driver for creativity and innovation. This is vividly illustrated in the three episodes where developers’ anxiety for the financial situation actually led to creative problem-solving. The solutions were unexpected and outside the box, but were eventually quite successful.

We see that the problem and the context trigger an emotion with the developers. If the problem is perceived as having an immediate simple solution, it triggers what we see as rational problem-solving and requires no creative action. If the problem is perceived as more challenging with a higher level of friction, it will trigger an emotional response by the developers in the form of worry or anxiety. This response will lead the developers to think creatively about solving the problem leading to a creative result. We illustrate these relationships in Fig. 1. We find that the problem and context determine whether the solution is found through rational problem-solving or creative problem-solving driven by worry or anxiety. Creativity is closely linked

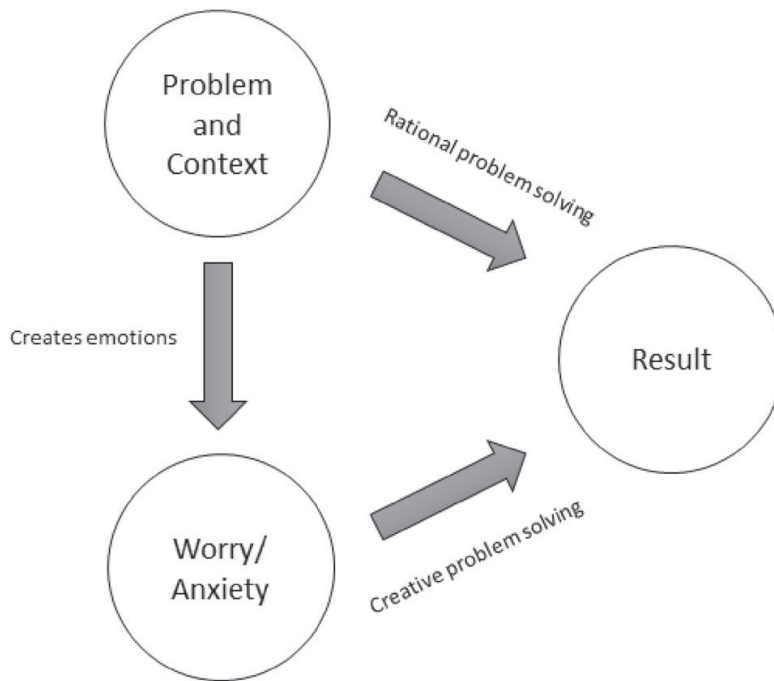


Fig. 1 Theoretical model of worry/anxiety and creative problem-solving

to the context, and the interplay of individuals and their work environment (Perry-Smith and Shalley 2014). In our analysis we see that the context differs for each situation, and that in the case where the developers express worry the situation is not critical or imminent, giving the developers time to address the problem and work out a solution. Problems that lead to a sense of worry or anxiety are experienced as more challenging with a higher level of friction than the ones that produce rational solutions.

In the case of situations prone to anxiety, the companies reported challenging financial situations during the study. Not being able to generate the necessary income to pay the employees, buy necessary software and market their product increases management's anxiety, as they feel responsible for such situations. The employees experienced anxiety in situations where there is obvious turbulence in the company as they become uncertain about their positions and future. According to Bullough and Renko (2013), starting a business or pursuing new ventures is often done during difficult circumstances and one has to alter the status quo and forge new paths in order to succeed, which resonates with our findings. The uncertainty of the outcome and the need for a quick solution promoted creative solutions. What we observe is a friction occurring in the company when met with these challenges, and the degree of imminence determines whether it is experienced through worry, anxiety or rationale. We also see that if the survival of the company or the product is at stake during such turmoil, the level of anxiety is quite high. As the developers, both management and employees, experience a personal dedication and ownership of the company and the game, it becomes an important part of themselves and their lives. They are driven by intrinsic motivation that fuels creativity. According to May (1996) "Anxiety is the apprehension cued off by a threat to some value that the individual holds essential to his existence as a personality" (p. 189). Hence, the anxiety

they experience provoked by financially unstable situations and their intrinsic motivation and enjoyment of game development drives creative problem-solving.

We also found that technology plays an important role as either the cause or the solution to the problems. This is in line with previous research stating that creative and technological resources can represent an opportunity and a tool to gain control over challenging situations (Zackariasson et al. 2006). As the game developers are both creative and technologically savvy, they approach problems with the skills and necessary knowledge to find creative solutions.

Our conclusion is therefore that the particular existential situation of game developer start-ups, which are characterized by uncertainty and strong financial pressures, triggers worry and anxiety. Somewhat surprisingly, game developers were able to exploit even anxiety to devise creative technical solutions.

5.2 Practical Contribution

First, at a practical level we do find that the managers and the developers experience situations leading to worry or anxiety both on a personal and social level. They deal with these situations through creative problem-solving; thus, both worry and anxiety lead to a creative result. As discussed in Sect. 5.1, friction provokes creative problem-solving through the emotions of worry and anxiety. The practical question is what happens when there is no friction, should one provoke the state of worry or anxiety to increase the creative output?

From our study a few situations were reported of that involved simulating an environment challenging the skills and knowledge of the developers. The notion of “creative slack” where a firm’s knowledge and experience give rise to “excess” resources is an important reservoir of opportunities, which can lead to future growth for the company (Lê et al. 2013). One event was an internal game jam, where the team gathered for the purpose of planning, designing and creating one game within 2 weeks. The aim was to develop a mobile game which they had little experience with making, challenging their limits and knowledge. The result was an innovative game they found good enough to publish after some internal testing and bug fixing. This is an example of how creative slack can be accessed and put into use during game jams.

“We have learned to create games in very short time, a new experience for all of us... We now know that we have the capacity, expertise and focus to make other games in a short period of time. It’s a good experience to see what others can contribute and how quickly and accurately they work”. – Company E

This could be characterized as *controlled friction* where one simulates a chaotic environment to provoke emotional responses such as worry and anxiety to increase the creative output in a company who experience a standstill in their production of novel products. What is important to note is that one must make sure the team is intrinsically motivated to participate in such an activity. If the decision is imposed on the team by management and not communicated to the team as a collective effort, the potential for creative output will be hindered.

Company C reported that they allow and encourage their employees to work on projects on their own time outside of the company as it will increase their skill and knowledge level and benefit the company. This led to several creative and innovative solutions. This situation is not immediately related to worry or anxiety, though there is a risk in allowing employees to work on other projects as it could lead to them leaving the team to work somewhere else. This would cause tension for the company and management. On the other hand, one could argue that the level of intrinsic motivation would increase as the developers feel they are free to explore their own interests in external projects further enhancing their contribution in the company. Hence, the benefits outweigh the risks.

5.3 Limitations

This study is limited by virtue as it involves only small-to-medium sized companies. Despite its limitations, we have generalized from our empirical account to theoretical statements. The financial and adoption “factors” could differ depending on the context/case. Hence, we encourage other researchers to follow in our footsteps and investigate the extent to which these and other episodes are characterized by worry or anxiety in different contexts. It would be of special interest to conduct studies in larger or AAA-development studios as a comparison.

6 Conclusion

In this paper, we presented a case study of six Norwegian video game development companies in our effort to answer the research question: *How do top video game developers exploit anxiety in their creative process?*

After comprehensive analysis we chose six to represent our findings. Three were characterized with worry and were triggered by challenges in game adoption, while three were characterized with anxiety and were triggered by financial challenges. Through the identification of these episodes we provide a more nuanced insight on anxiety and creativity. The model- and case-specific examples illustrate that the problem and context determine whether the solution is found through rational problem-solving or creative problem-solving driven by worry or anxiety. We found a high level of intrinsic motivation among the developers as well, which is a driver for creativity. The technology functioned as a cause or solution to the problems.

In conclusion we find a causal link between the emotional state of worry and anxiety and its context leading to a creative solution. This is presented through case examples and illustrated in a theoretical model. Further research should investigate the phenomenon in other contexts.

Compliance with Ethical Standards

Conflict of interest On behalf of all authors, the corresponding author states that there is no conflict of interest.

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